APC-2022/0020-0023-C

ChristianaCare

4755 Ogletown-Stanton Road
Newark, DE 19718

October 1, 2021

Mr. Joe Koetas
State of Delaware - DNREC
Division of Air Quality
State Street Commons
100 W. Water Street, Suite 6A
Dover, DE 19904

Re: Christiana Care Health System
Logistics Center Permit Application

Dear Mr. Koetas:

We are enclosing an electronic copy of an air permit application for four new emergency generators at our new Logistics Center facility in Newark. A check in the amount of $1,185.00 is being transmitted separately as required for the advertisement and permit fees.

Our understanding is that Astro Power occupied the facility in the early 2000s and had a permitted emergency generator at that time. Christiana Care is conducting building renovations and removed that generator in January 2021. Christiana Care is modifying the existing building for use in storing medical and pharmaceutical supplies. The generators will provide backup power for lighting, a fire pump, fire alarm, air handling units and other warehousing operations. The use of the facility and renovations being made are consistent with the zoning for the property (BP – UDC – Business Park).

Should you need additional information, please don't hesitate to contact me at JKrebs@Christianacare.org or at (302) 733-3788.

Sincerely,

Christiana Care Health Services

Jeffrey G. Krebs
Mechanical Engineering Manager

JGK/bl

Administrative Information

One original and one copy of All Application Forms Should Be Mailed To:
Division of Air Quality
100 West Water Street, Suite 6A
Dover, DE 19904

All Checks Should Be Made Payable To:
State of Delaware

Company and Site Information

1.	Company Name: **Christiana Care Health Services**		
2.	Company Mailing Address: **4755 Ogletown - Stanton Road**		
	City: **Newark**	State: **Delaware**	Zip Code: **19718**
3.	Site Name: **Christiana Care Logistics Center**		
4.	Site Mailing Address: **300 Executive Drive** *(if different from above)*		
	City: **Newark**	State: **Delaware**	Zip Code: **19702**
5.	Physical Location of Site: **300 Executive Drive** *(if different from above)*		
	City: **Newark**	State: **Delaware**	Zip Code: **19702**
6.	Site Billing Address: **4755 Ogletown - Stanton Road** *(if different from above)*		
	City: **Newark**	State: **Delaware**	Zip Code: **19718**
7.	Air Quality Management Facility ID Number:		
8.	Site NAICS Code): **493110** *(list all that apply*		
9.	Site SIC Code: **4225** *(list all that apply)*		
10.	Site Location Coordinates:	Latitude: 39 ° 36' 42" Longitude: -75 ° 44' 55"	
11.	Is the Facility New or Existing?	☒ NEW ☐ EXISTING	
If the Facility is an Existing Facility, Complete the Rest of Question 11. If Not, Proceed to Question 12.			
11.1.	Does the Facility Have Active Air Permits?	☐ YES	☒ NO
12.	Is this Application For New Equipment or a Modification to Existing Equipment? ☒ New Equipment ☐ Modification of Existing Equipment ☐ Other (Specify):		
If the application is for the modification of existing equipment, complete the rest of Question 12. If not, proceed to Question 13.			

Company and Site Information

12.1. Does the Equipment Have an Active Air Permit? ☐ YES ☐ NO

If the equipment has an active air permit, complete the rest of Question 12. If not, proceed to Question 13.

12.2. Permit Number of Existing Equipment:

13. Status of Equipment Being Applied For:
☒ Natural Minor Source
☐ Synthetic Minor Source
☐ Major Source
☐ Federally Enforceable Restrictions

14. Facility Status: ☒ Natural Minor Facility ☐ Synthetic Minor Facility ☐ Major Facility

If the facility is a Major Source, complete the rest of Question 14. If not, proceed to Question 15.

14.1. Responsible Official Name:

14.2. Responsible Official Title:

Contact Information

15. Name of Owner or Facility Manager: **Christiana Care Health Services**

16. Title of Owner or Facility Manager: **NA**

17. Permit Contact Name: **Jeffrey G. Krebs**

18. Permit Contact Title: **Mechanical Engineering Manager**

19. Permit Contact Telephone Number: **(302) 733-3788**

20. Permit Contact Fax Number: **(302) 733-3742**

21. Permit Contact E-Mail Address: **JKrebs@ChristianaCare.org**

22. Billing Contact Name: **Penny Gravenor**

23. Billing Contact Title: **Administrative Assistant**

24. Billing Contact Telephone Number: **(302) 733-3757**

25. Billing Contact Fax Number: **(302) 733-3742**

26. Billing Contact E-Mail Address: **PeGravenor@ChristianaCare.org**

Proposed Construction and Operating Schedule

27. When Will the Proposed Construction/Installation/Modification Occur: 3/31/2022

28. Proposed Operating Schedule: **24** hours/day **7** days/week **52** weeks/year

28.1. Is There Any Additional Information Regarding the Operating Schedule? ☒ YES ☐ NO

If YES, complete the rest of Question 28. If NO, proceed to Question 29.

Proposed Construction and Operating Schedule

28.2. Describe the Additional Information: **Facility requests maximum 500 hours of operation per year on an as-needed basis.**

Coastal Zone Information

29. Is the Facility Located in the Coastal Zone? ☐ YES ☒ NO

If the facility is located in the Coastal Zone complete the rest of Question 29. If not, proceed to Question 30.

29.1. Is a Coastal Zone Permit Required for Construction or Operation of the Source Being Applied for? ☐ YES ☐ NO

Attach a copy of the Coastal Zone Determination if it has not been previously submitted

If a Coastal Zone Permit is required complete the rest of Question 29. If not, proceed to Question 30.

29.2. Has a Coastal Zone Permit Been Issued? ☐ YES ☐ NO

Attach a copy of the Coastal Zone Permit if it has not been previously submitted

Local Zoning Information

30. Parcel Zoning: **BP-UDC-Business Park**

Attach Proof of Local Zoning if it has not been previously submitted

Application Information

31. Is the Appropriate Application Fee Attached? ☒ YES ☐ NO

32. Is the Advertising Fee Attached? ☒ YES ☐ NO

For help determining your application and advertising fees see:
http://www.dnrec.state.de.us/DNREC2000/Library/Fees/DE%20Permit%20Fees.htm

Attach the appropriate fees. Note that your Application will not be considered complete if the appropriate fees are not included.

33. Is a Cover Letter Describing the Process Attached? ☒ YES ☐ NO

Attach a brief cover letter describing your Application.

If the Facility is a New Facility complete Question 34. If not, proceed to Question35.

34. Is a Copy of the Applicant Background Information Questionnaire on Record at the Department? ☐ YES ☐ NO

If NO, complete the rest of Question 34. If YES, process to Question 35.

34.1 Is a Copy of the Applicant Background Information Questionnaire Attached? ☐ YES ☐ NO

For a copy of the Applicant Background Information Questionnaire see
http://www.dnrec.delaware.gov/services/Documents/Chapter79Form.pdf

Attach a copy of the Applicant Background Information Questionnaire if applicable.

35. Check Which Application Forms are Attached:

Application Information

☒ AQM-1	☐ AQM-3.4	☐ AQM-3.9	☐ AQM-3.14	☐ AQM-4.4	☐ AQM-4.9	☐ AQM-6
☒ AQM-2	☐ AQM-3.5	☐ AQM-3.10	☐ AQM-3.15	☐ AQM-4.5	☐ AQM-4.10	
☐ AQM-3.1	☐ AQM-3.6	☐ AQM-3.11	☐ AQM-4.1	☐ AQM-4.6	☐ AQM-4.11	
☐ AQM-3.2	☐ AQM-3.7	☐ AQM-3.12	☐ AQM-4.2	☐ AQM-4.7	☐ AQM-4.12	
☒ AQM-3.3	☐ AQM-3.8	☐ AQM-3.13	☐ AQM-4.3	☐ AQM-4.8	☒ AQM-5	

36. Check Which Documents are Attached:

- ☐ Coastal Zone Determination
- ☐ Coastal Zone Permit
- ☒ Proof of Local Zoning
- ☒ Application Fee
- ☒ Advertising Fee
- ☐ Applicant Background Information Questionnaire
- ☐ Claim of Confidentiality
- ☒ Manufacturer Specification(s)
- ☐ Material Safety Data Sheets (MSDSs)
- ☒ Supporting Calculations
- ☒ Descriptive Cover Letter
- ☐ Other (Specify):

Confidentiality Information

37. Do You Consider Any of the Information Submitted With this Application Confidential? ☐ YES ☒ NO

For help on how to submit a confidentiality claim see
http://regulations.delaware.gov/register/december2011/final/15%20DE%20Reg%20864%2012-01-11.htm

If a Claim of Confidentiality is made it MUST meet the requirements of Section 6 of DNREC's Freedom of Information ("FOIA") Regulation at the time the Application is submitted.

Signature Block

I, the undersigned, hereby certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all of its attachments as to the truth, accuracy, and completeness of this information. I certify based on information and belief formed after reasonable inquiry, the statements and information in this document are true, accurate, and complete. By signing this form, I certify that I have not changed, altered, or deleted any portions of this application. I acknowledge that I cannot commence construction, alteration, modification or initiate operation until I receive written approval (i.e. permit, registration, or exemption letter) from the Department. I acknowledge that I may be required to perform testing of the equipment to receive construction or operation approval, and that if I do not receive approval to construct or operate that I may appeal the decision.

Jill J. Karpinski
Owner or Operator

10/1/21
Date

Signature of Owner or Operator

One Original and One Copy of All Application Forms Should Be Mailed To:
Division of Air Quality
100 W. Water Street, Suite 6A
Dover, Delaware 19904

All Checks Should Be Made Payable To:
State of Delaware

Parcel # 1102100050

Property Address: 300 EXECUTIVE DR
NEWARK, DE 19702-
Subdivision: PENCADER CORP CTR
Owner: CHRISTIANA CARE HEALTH SERVICES INC
REAL ESTATE AND PROPERTY MANAGEMENT
Owner Address: 4735 OGLETOWN-STANTON ROAD
NEWARK, DE 19713
Municipal Info: Unincorporated

Lot #: 34A
Location:
Map Grid: 05803280
Block:
Census Tract: 148.07
Street Type:
Water:
Microfilm #: 200512290133214

Property Class: EXEMPT COMMERCIAL
Lot Size: 16.90
Lot Depth: 0
Lot Frontage: 0
Street Finish:

Related Project Plans

	A/P No.	Project Name	Work Type	Status
Details	20000631	PENCADER CORP. CTR. PAR. 34A	MINOR LAND DEVELOPMENT	RECORDED/RESOLV
Details	20010185	PAUL MCCONNELL	BOARD OF ADJUSTMENT	COMPLETE
Details	20010579	PENCADER CORP. CTR. PAR. 34A	MINOR LAND DEVELOPMENT	COMPLETE
Details	20020201	MCBRIDE & ZIEGLER	ZONING VERIFICATION PROCESS	COMPLETE
Details	20050954	ASTRO MIDDLE SCHOOL	RESUBDIVISION	RECORDED/RESOLV
Details	20170132	300 EXECUTIVE DRIVE	ZONING VERIFICATION PROCESS	COMPLETE
Details	20170180	300 EXECUTIVE DRIVE	ZONING VERIFICATION PROCESS	COMPLETE
Details	20200585	300 EXECUTIVE DRIVE	ZONING VERIFICATION PROCESS	COMPLETE
Details	20200756	300 EXECUTIVE DRIVE	RESUBDIVISION	Active
Details	20200758	300 EXECUTIVE DRIVE	FLOODPLAIN APPLICATION	ACTIVE
Details	20210038	300 EXECUTIVE DRIVE	RESOURCE PROTECTION AREA	COMPLETE
Details	20210239	300 EXECUTIVE DRIVE	BOARD OF ADJUSTMENT	COMPLETE

Permit History (July 1998 – present)

	A/P No.	Permit Type	Status
Details	202110248	COMMERCIAL TENANT FITOUT	Open
Details	202110242	COMMERCIAL TENANT FITOUT	Open
Details	200614054	HVAC PERMIT	Closed
Details	200211325	COMMERCIAL BUILDING PERMIT	Closed
Details	200115673	PLUMBING PERMIT	Closed
Details	200114795	HVAC PERMIT	Closed
Details	200114171	COMMERCIAL TENANT FITOUT	Closed
Details	200114033	PLUMBING PERMIT	Closed
Details	200111480	PLUMBING PERMIT	Closed
Details	200109246	COMMERCIAL BUILDING PERMIT	Closed

District & Zoning Info

Districts

- **COUNCIL 11 - DAVID L TACKETT**
- **FIRE/RESCUE - AETNA H H & L**
- **CHRISTINA SCHOOL DIST-TRES**
- NORTH OF C&D CANAL
- DE SEN 10-STEPHANIE L HANSEN
- DE REP 27-ERIC A MORRISON
- SEWER DISTRICT NORTHERN-ASMT
- FLOODPLAIN
- PLANNING 4 - CENTRAL PENCADER
- TRAFFIC ZONE T180 (YR2000)
- **PENCADER CORPORATE CENTER - Maintenance Corporation**
- PENCADER CORPORATE CENTER - Civic Organization - no contact information available
- WETLANDS-LU

Zoning

- BP - UDC - BUSINESS PARK

Deed History

Grantee(s)	Deed	Multi?	Sale Date	Sale Amount
SHRINERS HOSPITALS FOR CHILDRE	2222 80	Y	12/10/1996	$10.00
34A EXECUTIVE PROPERTIES L L C	2611 158	N	3/18/1999	$10.00
SEDONA LAKE LLC	2944 103	N	12/21/2000	$10.00
CHRISTINA SCHOOL DISTRICT	20050311 0023454	N	3/1/2005	$10.00
DEL MONTE FRESH PRODUCE N A INC.	20170524 0025902	N	5/23/2017	$10.00
CHRISTIANA CARE HEALTH SERVICES INC	20201125 0106858	N	11/23/2020	$10.00

Tax/Assessment Info

Assessment

Land:	350700
Structure:	4364500
Homesite:	0
Total:	4715200
County Taxable:	0
School Taxable:	0

Exemptions

Description	Amount
HEALTH / HOSPITAL	4715200

Tax Bills as of 9/8/2021 3:00:33 AM

	County			School		
Tax Year	Principal Due	Penalty Due	Amt Paid	Principal Due	Penalty Due	Amt Paid
2017A	$0.00	$0.00	$34,175.30	$0.00	$0.00	$120,015.99
2017Q1	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
2018A	$0.00	$0.00	$36,651.94	$0.00	$0.00	$123,208.18
2019A	$0.00	$0.00	$38,919.73	$0.00	$0.00	$125,235.71
2020A	$0.00	$0.00	$39,157.38	$0.00	$0.00	$146,605.00

Tax Payments as of 9/8/2021 3:00:33 AM

Date Paid	Amt Paid
11/16/2017	$120,015.99
11/16/2017	$34,175.30
10/2/2018	$159,860.12
10/2/2019	$164,155.44
9/25/2020	$25,000.00
9/25/2020	$25,000.00
9/25/2020	$25,000.00
9/25/2020	$25,000.00
9/25/2020	$25,000.00
9/25/2020	$10,762.38
9/25/2020	$25,000.00
9/25/2020	$25,000.00

County Balance Due: $0.00

School Balance Due: $0.00

These amounts are valid through the last day of the month. For accounts with delinquent balances, statutory penalty will accrue on the first day of next month.

Sewer History as of 9/8/2021 3:01:33 AM

Tax Year	Principal Due	Penalty Due	Date Paid	Amount Paid
2007S1	$0.00	$0.00	2/7/2007	$79.01
2007S2	$0.00	$0.00	5/22/2007	$79.01
2007S3	$0.00	$0.00	7/31/2007	$79.01
2007S4	$0.00	$0.00	11/19/2007	$79.01
2010S1	$0.00	$0.00	2/18/2010	$61.35
2010S2	$0.00	$0.00	5/11/2010	$61.35
2010S3	$0.00	$0.00	8/5/2010	$63.81
2010S4	$0.00	$0.00	11/15/2010	$63.81
2011S1	$0.00	$0.00	2/25/2011	$12.50
2011S2	$0.00	$0.00	5/3/2011	$12.50
2011S3	$0.00	$0.00	8/11/2011	$12.50
2011S4	$0.00	$0.00	11/30/2011	$12.50
2012S1	$0.00	$0.00	2/10/2012	$16.57
2012S2	$0.00	$0.00	5/3/2012	$16.57
2012S3	$0.00	$0.00	7/19/2012	$16.57
2012S4	$0.00	$0.00	11/8/2012	$16.57
2013S1	$0.00	$0.00	2/7/2013	$33.15
2013S2	$0.00	$0.00	5/6/2013	$33.15
2013S3	$0.00	$0.00	8/1/2013	$34.44
2013S4	$0.00	$0.00	11/19/2013	$34.44
2014S1	$0.00	$0.00	2/26/2014	$51.66
2014S2	$0.00	$0.00	5/13/2014	$51.66
2014S3	$0.00	$0.00	8/12/2014	$51.66
2014S4	$0.00	$0.00	11/13/2014	$51.66
2015S1	$0.00	$0.00	5/4/2015	$36.84
2015S2	$0.00	$0.00	5/4/2015	$34.44
2015S3	$0.00	$0.00	8/28/2015	$34.44
2015S4	$0.00	$0.00	11/5/2015	$34.44
2016S1	$0.00	$0.00	2/3/2016	$63.14
2016S2	$0.00	$0.00	5/4/2016	$63.14
2016S3	$0.00	$0.00	8/26/2016	$63.14
2016S4	$0.00	$0.00	11/18/2016	$63.14
2017S1	$0.00	$0.00	2/27/2017	$34.44
2017S2	$0.00	$0.00	5/8/2017	$34.44
2017S3	$0.00	$0.00	8/7/2017	$34.44
2017S4	$0.00	$0.00	5/1/2018	$37.86
2018S1	$0.00	$0.00	8/27/2018	$13.47
2018S2	$0.00	$0.00	8/27/2018	$13.52

2018S3	$0.00	$0.00	8/27/2018	$14.00
2018S4	$0.00	$0.00	11/30/2020	$18.06
2019S1	$0.00	$0.00	11/30/2020	$17.64
2019S2	$0.00	$0.00	11/30/2020	$17.22
2019S3	$0.00	$0.00	11/30/2020	$16.80
2019S4	$0.00	$0.00	11/30/2020	$16.38
2020S1	$0.00	$0.00	11/30/2020	$73.26
2020S2	$0.00	$0.00	11/30/2020	$71.34
2020S3	$0.00	$0.00	11/30/2020	$69.42
2020S4	$0.00	$0.00	4/22/2021	$64.51
2021S1	$0.00	$0.00	4/22/2021	$75.68
2021S2	$0.00	$0.00	4/22/2021	$70.72
2021S3	$695.72	$0.00	Not Available	$0.00

Balance Due: $695.72

These amounts do not reflect statutory penalty, which was imposed on the first of the month. To obtain the exact amount necessary to pay the account in full, please call New Castle County's Treasury Division at (302) 395-5340.

Commercial Structure Characteristics

Building #:

Occupancy:	432	# of Stories:	1	Year Built:	2002
Struct Class:	S	Quality:	D+	Condition:	AV
Floor Level:	U	Grnd Flr Area:	9660	Total Flr Area:	9660
Ext Wall Type:		Wall Height:	12	Perimeter:	512
AC %:	0	Heat %:	0	Rentable Units:	1
Bsmt:	0	Bsmt Util:			
Year Renov:	0	Renov Rtng:		Eff. Yr Built:	0

Building #:

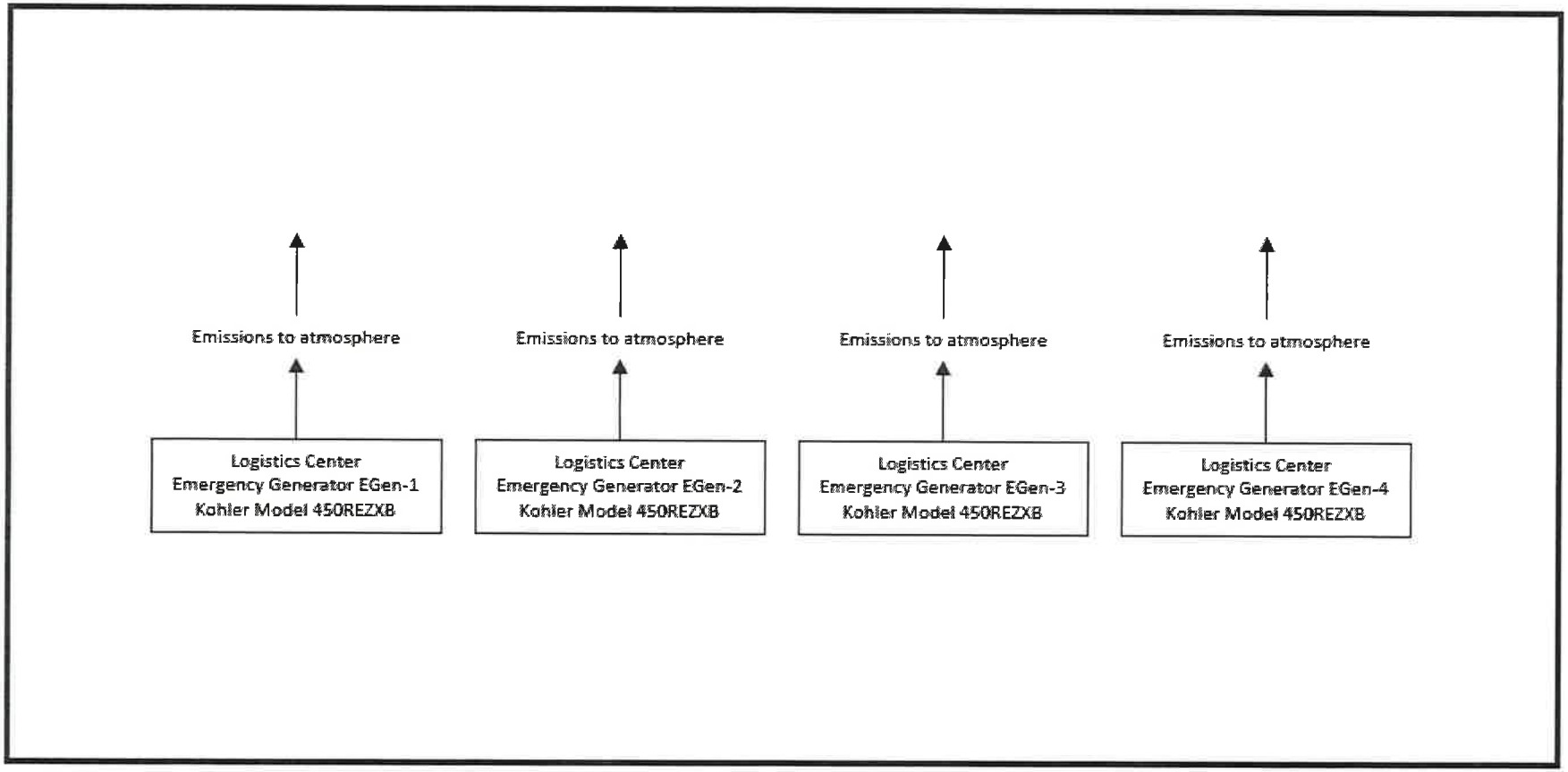
Occupancy:	440	# of Stories:	1	Year Built:	2002
Struct Class:	B	Quality:	C+	Condition:	AV
Floor Level:	A	Grnd Flr Area:	100686	Total Flr Area:	100686
Ext Wall Type:	05	Wall Height:	30	Perimeter:	1304
AC %:	100	Heat %:	100	Rentable Units:	1
Bsmt:	0	Bsmt Util:	0		
Year Renov:	0	Renov Rtng:	0	Eff. Yr Built:	1983

Building #:

Occupancy:	440	# of Stories:	2	Year Built:	2002
Struct Class:	B	Quality:	C+	Condition:	AV
Floor Level:	A	Grnd Flr Area:	29855	Total Flr Area:	59504
Ext Wall Type:	05	Wall Height:	15	Perimeter:	1678
AC %:	100	Heat %:	100	Rentable Units:	1
Bsmt:	0	Bsmt Util:	0		
Year Renov:	0	Renov Rtng:	0	Eff. Yr Built:	1983

Process Flow Diagram

Sketch the Process Flow Diagram for the equipment or process being applied for. Include each emission unit and control device (even existing emission units that will not be modified by this application). You may identify each emission unit with a simple shape. Label each emission unit and control device with a unique identifier. Show the relationship between each emission unit and/or control device by drawing arrows between them to indicate the flow of air pollutants. List which application forms are included for each emission unit or control device below the shape representing each emission unit or control device. See http://www.delaware.gov/reg2/default.htm for example Process Flow Diagrams for common processes. If you already have a Process Flow Diagram for the equipment or process being applied for, you may attach it to the application instead of using this form.



Generator/Engine Application

If you are using this form electronically, press F1 at any time for help

General Information

1. Facility Name: **Christiana Care Logistics Center**
2. Equipment ID: **EGen-1**
3. Manufacturer: **Kohler**
4. Model: **450REZXB**
5. Serial Number: **TBD**
6. Maximum Power Rating of Engine: **684** horsepower
7. Standby Power Rating of Generator: **450** kilowatt
8. Date of Manufacture: **2021**
9. Installation Date: **Planned 3/31/22**
10. Is the Equipment Being Applied For a Generator or an Engine? ☒ Generator ☐ Engine

If the equipment is a Generator, complete the rest of Question 10. If not, proceed to Question 11.

10.1. Is the Generator Existing or New? ☐ Existing ☒ New

10.2. Will the Generator Be Classified as an Emergency Generator or a Distributed Generator? ☒ Emergency ☐ Distributed

10.3. Has an Initial Notification Pursuant to 7 **DE Admin. Code** 1144 Been Submitted for this Generator? ☒ YES ☐ NO

If NO, include a copy of the Initial Notification with this application.

10.4. Have the Emissions From the Generator Been Certified to Meet the Currently Applicable US EPA Non-Road Emission Standards? ☒ YES ☐ NO

If YES, attach a copy of the Manufacturer's Certification. If NO, attach copies of any/all of the following: any maintenance or operating requirements/instructions provided by the generator manufacturer; the type, or a description, of any emission control equipment use; and/or emissions test data for the generator (such as a manufacturer's technical data sheet), any supporting documentation for any emission control equipment used, any supporting calculations, any quality control or assurance information, and any other information needed to demonstrate compliance with the requirements. Proceed to Question 11.

11. Primary Fuel: ☒ Natural Gas ☐ Diesel ☐ Propane ☐ Biodiesel ☐ Other (specify):

11.1. Maximum Annual Primary Fuel Consumption: **46.37 MMCF**

11.2. Heat Content of Primary Fuel: **1,050 BTU/CF**

11.3. Maximum Firing Rate: **0.005293 MMCF/hr**

11.4. Percent Sulfur of Primary Fuel: **NA** %

12. Secondary Fuel: ☐ Natural Gas ☐ Diesel ☐ Propane ☐ Biodiesel ☐ Other (specify): **NA**

General Information

12.1.	Maximum Annual Secondary Fuel Consumption: **MMCF**
12.2.	Heat Content of Secondary Fuel: **BTU/CF**
12.3.	Maximum Firing Rate: **MMCF/hr**
12.4.	Percent Sulfur of Secondary Fuel: %
13.	Is SCR/NSCR/SNCR/Ammonia Injection Used: ☐ YES ☒ NO

Stack Information

14. How Does the Process Equipment Vent:
(check all that apply)
☒ Directly to the Atmosphere
☐ Through a Control Device Covered by Forms AQM-4.1 through 4.12

If any of the process equipment vents directly to the atmosphere proceed to Question 15. If the process equipment vents through a control device, provide the stack parameters on the control device form and proceed to Question 16.

15. Emission Point Name: **EGen-1**

15.1. Stack Height Above Grade: **8.85 feet**

15.2. Stack Exit Diameter: **0.42 for each of 2 stacks feet**
(Provide Stack Dimensions If Rectangular Stack)

15.3. Is a Stack Cap Present? ☒ YES ☐ NO

15.4. Stack Configuration: ☒ Vertical ☐ Horizontal ☐ Downward-Venting
(check all that apply) ☐ Other (Specify):

15.5. Stack Exit Gas Temperature: **1,136 °F**

15.6. Stack Exit Gas Flow Rate: **2,529 ACFM**

15.7. Distance to Nearest Property Line: **26 ft**

15.8. Describe Nearest Obstruction: **Logistics Center building**

15.9. Height of Nearest Obstruction: **35 ft**

15.10. Distance to Nearest Obstruction: **23 ft**

15.11. Are Stack Sampling Ports Provided? ☐ YES ☒ NO

Monitoring Information

16. Will Emissions Data be Recorded by a Continuous Emission Monitoring System? ☐ YES ☒ NO

If Yes, Attach a Copy of the Continuous Emission Monitoring System Manufacturer's Specification Sheets

If YES, complete the rest of Question 16. If NO, proceed to Question 17.

16.1. Pollutants Monitored: ☐ VOCs ☐ HAPs ☐ PM ☐ PM_{10} ☐ $PM_{2.5}$ ☐ NO_X ☐ SO_X ☐ Metals
☐ Other (Specify):

16.2. Describe the Continuous Emission Monitoring System:

Monitoring Information

16.3. Manufacturer:

16.4. Model:

16.5. Serial Number:

16.6. Will Multiple Emission Units Be Monitored at the Same Point? ☐ YES ☐ NO

If YES, complete the rest of Question 16. If NO, proceed to Question 17.

16.7. Emission Units Monitored:

16.8. Will More Than One Emission Unit be Emitting From the Combined Point At Any Time? ☐ YES ☐ NO

If YES, complete the rest of Question 15. If NO, proceed to Question 17.

16.9. Emission Units Emitting Simultaneously:

Visible Emissions Monitoring Information

For Primary Fuel

17. Proposed Technique Used to Monitor Visible Emissions:
☐ Opacity Monitor (COM)
☐ Manual (Method 9)
☒ Manual (Method 22)
☐ Other (Describe):

If an Opacity Monitor (COM) is used, complete the rest of Question 17. If not, proceed to Question 18.

17.1. Describe the Continuous Opacity Monitoring System:

17.2. Manufacturer:

17.3. Model:

17.4. Serial Number:

18. Proposed Frequency of Opacity Monitoring: **Monthly**

For Secondary Fuel. If no Secondary Fuel is used, proceed to Question 20.

19. Proposed Technique Used to Monitor Visible Emissions:
☐ Opacity Monitor (COMs)
☐ Manual (Method 9)
☐ Manual (Method 22)
☐ Other (Describe):

If an Opacity Monitor (COMs) is used, complete the rest of Question 19. If not, proceed to Question 20.

19.1. Describe the Continuous Opacity Monitoring System:

19.2. Manufacturer:

19.3. Model:

19.4. Serial Number:

20. Proposed Frequency of Opacity Monitoring: **NA**

Voluntary Emission Limitation Request Information

21. Are You Requesting Any Voluntary Emission Limitations to Avoid Major Source Status, Minor New Source Review, MACT, NSPS, etc.? ☐ YES ☒ NO

If YES, complete the rest of Question 21. If NO, proceed to Question 22.

21.1. Describe Any Proposed Emission Limitations:

Voluntary Operating Limitation Request Information

22. Are You Requesting Any Voluntary Operating Limitations to Avoid Major Source Status, Minor New Source Review, MACT, NSPS, etc.? ☐ YES ☒ NO

If YES, complete the rest of Question 22. If NO, proceed to Question 23.

22.1. Describe Any Proposed Operating Limitations:

Additional Information

23. Is There Any Additional Information Pertinent to this Application? ☒ YES ☐ NO

If YES, complete the rest of Question 23.

22.1. Describe: **Facility requests maximum 500 hours of operation per year on an as-needed basis.**

Generator/Engine Application

If you are using this form electronically, press F1 at any time for help

General Information

1. Facility Name: **Christiana Care Logistics Center**
2. Equipment ID: **EGen-2**
3. Manufacturer: **Kohler**
4. Model: **450REZXB**
5. Serial Number: **TBD**
6. Maximum Power Rating of Engine: **684** horsepower
7. Standby Power Rating of Generator: **450** kilowatt
8. Date of Manufacture: **2021**
9. Installation Date: **Planned 3/31/22**
10. Is the Equipment Being Applied For a Generator or an Engine? ☒ Generator ☐ Engine

If the equipment is a Generator, complete the rest of Question 10. If not, proceed to Question 11.

10.1. Is the Generator Existing or New? ☐ Existing ☒ New

10.2. Will the Generator Be Classified as an Emergency Generator or a Distributed Generator? ☒ Emergency ☐ Distributed

10.3. Has an Initial Notification Pursuant to 7 **DE Admin. Code** 1144 Been Submitted for this Generator? ☒ YES ☐ NO

If NO, include a copy of the Initial Notification with this application.

10.4. Have the Emissions From the Generator Been Certified to Meet the Currently Applicable US EPA Non-Road Emission Standards? ☒ YES ☐ NO

If YES, attach a copy of the Manufacturer's Certification. If NO, attach copies of any/all of the following: any maintenance or operating requirements/instructions provided by the generator manufacturer; the type, or a description, of any emission control equipment use; and/or emissions test data for the generator (such as a manufacturer's technical data sheet), any supporting documentation for any emission control equipment used, any supporting calculations, any quality control or assurance information, and any other information needed to demonstrate compliance with the requirements. Proceed to Question 11.

11. Primary Fuel: ☒ Natural Gas ☐ Diesel ☐ Propane ☐ Biodiesel ☐ Other (specify):

11.1. Maximum Annual Primary Fuel Consumption: **46.37 MMCF**

11.2. Heat Content of Primary Fuel: **1,050 BTU/CF**

11.3. Maximum Firing Rate: **0.005293 MMCF/hr**

11.4. Percent Sulfur of Primary Fuel: **NA** %

12. Secondary Fuel: ☐ Natural Gas ☐ Diesel ☐ Propane ☐ Biodiesel ☐ Other (specify): **NA**

General Information

12.1.	Maximum Annual Secondary Fuel Consumption: **MMCF**
12.2.	Heat Content of Secondary Fuel: **BTU/CF**
12.3.	Maximum Firing Rate: **MMCF/hr**
12.4.	Percent Sulfur of Secondary Fuel: %
13.	Is SCR/NSCR/SNCR/Ammonia Injection Used: ☐ YES ☒ NO

Stack Information

14. How Does the Process Equipment Vent:
(check all that apply)
☒ Directly to the Atmosphere
☐ Through a Control Device Covered by Forms AQM-4.1 through 4.12

If any of the process equipment vents directly to the atmosphere proceed to Question 15. If the process equipment vents through a control device, provide the stack parameters on the control device form and proceed to Question 16.

15. Emission Point Name: **EGen-2**

15.1. Stack Height Above Grade: **8.85 feet**

15.2. Stack Exit Diameter: **0.42 for each of 2 stacks feet**
(Provide Stack Dimensions If Rectangular Stack)

15.3. Is a Stack Cap Present? ☒ YES ☐ NO

15.4. Stack Configuration: ☒ Vertical ☐ Horizontal ☐ Downward-Venting
(check all that apply) ☐ Other (Specify):

15.5. Stack Exit Gas Temperature: **1,136 °F**

15.6. Stack Exit Gas Flow Rate: **2,529 ACFM**

15.7. Distance to Nearest Property Line: **35 ft**

15.8. Describe Nearest Obstruction: **Logistics Center building**

15.9. Height of Nearest Obstruction: **35 ft**

15.10. Distance to Nearest Obstruction: **23 ft**

15.11. Are Stack Sampling Ports Provided? ☐ YES ☒ NO

Monitoring Information

16. Will Emissions Data be Recorded by a Continuous Emission Monitoring System? ☐ YES ☒ NO

If Yes, Attach a Copy of the Continuous Emission Monitoring System Manufacturer's Specification Sheets

If YES, complete the rest of Question 16. If NO, proceed to Question 17.

16.1. Pollutants Monitored: ☐ VOCs ☐ HAPs ☐ PM ☐ PM_{10} ☐ $PM_{2.5}$ ☐ NO_X ☐ SO_X ☐ Metals
☐ Other (Specify):

16.2. Describe the Continuous Emission Monitoring System:

Monitoring Information

16.3. Manufacturer:

16.4. Model:

16.5. Serial Number:

16.6. Will Multiple Emission Units Be Monitored at the Same Point? ☐ YES ☐ NO

If YES, complete the rest of Question 16. If NO, proceed to Question 17.

16.7. Emission Units Monitored:

16.8. Will More Than One Emission Unit be Emitting From the Combined Point At Any Time? ☐ YES ☐ NO

If YES, complete the rest of Question 15. If NO, proceed to Question 17.

16.9. Emission Units Emitting Simultaneously:

Visible Emissions Monitoring Information

For Primary Fuel

17. Proposed Technique Used to Monitor Visible Emissions:
☐ Opacity Monitor (COM)
☐ Manual (Method 9)
☒ Manual (Method 22)
☐ Other (Describe):

If an Opacity Monitor (COM) is used, complete the rest of Question 17. If not, proceed to Question 18.

17.1. Describe the Continuous Opacity Monitoring System:

17.2. Manufacturer:

17.3. Model:

17.4. Serial Number:

18. Proposed Frequency of Opacity Monitoring: **Monthly**

For Secondary Fuel. If no Secondary Fuel is used, proceed to Question 20.

19. Proposed Technique Used to Monitor Visible Emissions:
☐ Opacity Monitor (COMs)
☐ Manual (Method 9)
☐ Manual (Method 22)
☐ Other (Describe):

If an Opacity Monitor (COMs) is used, complete the rest of Question 19. If not, proceed to Question 20.

19.1. Describe the Continuous Opacity Monitoring System:

19.2. Manufacturer:

19.3. Model:

19.4. Serial Number:

20. Proposed Frequency of Opacity Monitoring: **NA**

Voluntary Emission Limitation Request Information

21. Are You Requesting Any Voluntary Emission Limitations to Avoid Major Source Status, Minor New Source Review, MACT, NSPS, etc.? ☐ YES ☒ NO

If YES, complete the rest of Question 21. If NO, proceed to Question 22.

21.1. Describe Any Proposed Emission Limitations:

Voluntary Operating Limitation Request Information

22. Are You Requesting Any Voluntary Operating Limitations to Avoid Major Source Status, Minor New Source Review, MACT, NSPS, etc.? ☐ YES ☒ NO

If YES, complete the rest of Question 22. If NO, proceed to Question 23.

22.1. Describe Any Proposed Operating Limitations:

Additional Information

23. Is There Any Additional Information Pertinent to this Application? ☒ YES ☐ NO

If YES, complete the rest of Question 23.

22.1. Describe: **Facility requests maximum 500 hours of operation per year on an as-needed basis.**

Generator/Engine Application

If you are using this form electronically, press F1 at any time for help

General Information

1. Facility Name: **Christiana Care Logistics Center**
2. Equipment ID: **EGen-3**
3. Manufacturer: **Kohler**
4. Model: **450REZXB**
5. Serial Number: **TBD**
6. Maximum Power Rating of Engine: **684** horsepower
7. Standby Power Rating of Generator: **450** kilowatt
8. Date of Manufacture: **2021**
9. Installation Date: **Planned 3/31/22**
10. Is the Equipment Being Applied For a Generator or an Engine? ☒ Generator ☐ Engine

If the equipment is a Generator, complete the rest of Question 10. If not, proceed to Question 11.

10.1. Is the Generator Existing or New? ☐ Existing ☒ New

10.2. Will the Generator Be Classified as an Emergency Generator or a Distributed Generator? ☒ Emergency ☐ Distributed

10.3. Has an Initial Notification Pursuant to 7 **DE Admin. Code** 1144 Been Submitted for this Generator? ☒ YES ☐ NO

If NO, include a copy of the Initial Notification with this application.

10.4. Have the Emissions From the Generator Been Certified to Meet the Currently Applicable US EPA Non-Road Emission Standards? ☒ YES ☐ NO

If YES, attach a copy of the Manufacturer's Certification. If NO, attach copies of any/all of the following: any maintenance or operating requirements/instructions provided by the generator manufacturer; the type, or a description, of any emission control equipment use; and/or emissions test data for the generator (such as a manufacturer's technical data sheet), any supporting documentation for any emission control equipment used, any supporting calculations, any quality control or assurance information, and any other information needed to demonstrate compliance with the requirements. Proceed to Question 11.

11. Primary Fuel: ☒ Natural Gas ☐ Diesel ☐ Propane ☐ Biodiesel ☐ Other (specify):

11.1. Maximum Annual Primary Fuel Consumption: **46.37 MMCF**

11.2. Heat Content of Primary Fuel: **1,050 BTU/CF**

11.3. Maximum Firing Rate: **0.005293 MMCF/hr**

11.4. Percent Sulfur of Primary Fuel: **NA** %

12. Secondary Fuel: ☐ Natural Gas ☐ Diesel ☐ Propane ☐ Biodiesel ☐ Other (specify): **NA**

General Information

12.1.	Maximum Annual Secondary Fuel Consumption: **MMCF**
12.2.	Heat Content of Secondary Fuel: **BTU/CF**
12.3.	Maximum Firing Rate: **MMCF/hr**
12.4.	Percent Sulfur of Secondary Fuel: %
13.	Is SCR/NSCR/SNCR/Ammonia Injection Used: ☐ YES ☒ NO

Stack Information

14. How Does the Process Equipment Vent:
(check all that apply)
☒ Directly to the Atmosphere
☐ Through a Control Device Covered by Forms AQM-4.1 through 4.12

If any of the process equipment vents directly to the atmosphere proceed to Question 15. If the process equipment vents through a control device, provide the stack parameters on the control device form and proceed to Question 16.

15. Emission Point Name: **EGen-3**

15.1. Stack Height Above Grade: **8.85 feet**

15.2. Stack Exit Diameter: **0.42 for each of 2 stacks feet**
(Provide Stack Dimensions If Rectangular Stack)

15.3. Is a Stack Cap Present? ☒ YES ☐ NO

15.4. Stack Configuration: ☒ Vertical ☐ Horizontal ☐ Downward-Venting
(check all that apply) ☐ Other (Specify):

15.5. Stack Exit Gas Temperature: **1,136 °F**

15.6. Stack Exit Gas Flow Rate: **2,529 ACFM**

15.7. Distance to Nearest Property Line: **44 ft**

15.8. Describe Nearest Obstruction: **Logistics Center building**

15.9. Height of Nearest Obstruction: **35 ft**

15.10. Distance to Nearest Obstruction: **23 ft**

15.11. Are Stack Sampling Ports Provided? ☐ YES ☒ NO

Monitoring Information

16. Will Emissions Data be Recorded by a Continuous Emission Monitoring System? ☐ YES ☒ NO

If Yes, Attach a Copy of the Continuous Emission Monitoring System Manufacturer's Specification Sheets

If YES, complete the rest of Question 16. If NO, proceed to Question 17.

16.1. Pollutants Monitored: ☐ VOCs ☐ HAPs ☐ PM ☐ PM_{10} ☐ $PM_{2.5}$ ☐ NO_X ☐ SO_X ☐ Metals
☐ Other (Specify):

16.2. Describe the Continuous Emission Monitoring System:

Monitoring Information

16.3. Manufacturer:

16.4. Model:

16.5. Serial Number:

16.6. Will Multiple Emission Units Be Monitored at the Same Point? ☐ YES ☐ NO

If YES, complete the rest of Question 16. If NO, proceed to Question 17.

16.7. Emission Units Monitored:

16.8. Will More Than One Emission Unit be Emitting From the Combined Point At Any Time? ☐ YES ☐ NO

If YES, complete the rest of Question 15. If NO, proceed to Question 17.

16.9. Emission Units Emitting Simultaneously:

Visible Emissions Monitoring Information

For Primary Fuel

17. Proposed Technique Used to Monitor Visible Emissions:
☐ Opacity Monitor (COM)
☐ Manual (Method 9)
☒ Manual (Method 22)
☐ Other (Describe):

If an Opacity Monitor (COM) is used, complete the rest of Question 17. If not, proceed to Question 18.

17.1. Describe the Continuous Opacity Monitoring System:

17.2. Manufacturer:

17.3. Model:

17.4. Serial Number:

18. Proposed Frequency of Opacity Monitoring: **Monthly**

For Secondary Fuel. If no Secondary Fuel is used, proceed to Question 20.

19. Proposed Technique Used to Monitor Visible Emissions:
☐ Opacity Monitor (COMs)
☐ Manual (Method 9)
☐ Manual (Method 22)
☐ Other (Describe):

If an Opacity Monitor (COMs) is used, complete the rest of Question 19. If not, proceed to Question 20.

19.1. Describe the Continuous Opacity Monitoring System:

19.2. Manufacturer:

19.3. Model:

19.4. Serial Number:

20. Proposed Frequency of Opacity Monitoring: **NA**

Voluntary Emission Limitation Request Information

21. Are You Requesting Any Voluntary Emission Limitations to Avoid Major Source Status, Minor New Source Review, MACT, NSPS, etc.? ☐ YES ☒ NO

If YES, complete the rest of Question 21. If NO, proceed to Question 22.

21.1. Describe Any Proposed Emission Limitations:

Voluntary Operating Limitation Request Information

22. Are You Requesting Any Voluntary Operating Limitations to Avoid Major Source Status, Minor New Source Review, MACT, NSPS, etc.? ☐ YES ☒ NO

If YES, complete the rest of Question 22. If NO, proceed to Question 23.

22.1. Describe Any Proposed Operating Limitations:

Additional Information

23. Is There Any Additional Information Pertinent to this Application? ☒ YES ☐ NO

If YES, complete the rest of Question 23.

22.1. Describe: **Facility requests maximum 500 hours of operation per year on an as-needed basis.**

Generator/Engine Application

If you are using this form electronically, press F1 at any time for help

General Information

1. Facility Name: **Christiana Care Logistics Center**
2. Equipment ID: **EGen-4**
3. Manufacturer: **Kohler**
4. Model: **450REZXB**
5. Serial Number: **TBD**
6. Maximum Power Rating of Engine: **684** horsepower
7. Standby Power Rating of Generator: **450** kilowatt
8. Date of Manufacture: **2021**
9. Installation Date: **Planned 3/31/22**
10. Is the Equipment Being Applied For a Generator or an Engine? ☒ Generator ☐ Engine

If the equipment is a Generator, complete the rest of Question 10. If not, proceed to Question 11.

10.1. Is the Generator Existing or New? ☐ Existing ☒ New

10.2. Will the Generator Be Classified as an Emergency Generator or a Distributed Generator? ☒ Emergency ☐ Distributed

10.3. Has an Initial Notification Pursuant to 7 **DE Admin. Code** 1144 Been Submitted for this Generator? ☒ YES ☐ NO

If NO, include a copy of the Initial Notification with this application.

10.4. Have the Emissions From the Generator Been Certified to Meet the Currently Applicable US EPA Non-Road Emission Standards? ☒ YES ☐ NO

If YES, attach a copy of the Manufacturer's Certification. If NO, attach copies of any/all of the following: any maintenance or operating requirements/instructions provided by the generator manufacturer; the type, or a description, of any emission control equipment use; and/or emissions test data for the generator (such as a manufacturer's technical data sheet), any supporting documentation for any emission control equipment used, any supporting calculations, any quality control or assurance information, and any other information needed to demonstrate compliance with the requirements. Proceed to Question 11.

11. Primary Fuel: ☒ Natural Gas ☐ Diesel ☐ Propane ☐ Biodiesel ☐ Other (specify):

11.1. Maximum Annual Primary Fuel Consumption: **46.37 MMCF**

11.2. Heat Content of Primary Fuel: **1,050 BTU/CF**

11.3. Maximum Firing Rate: **0.005293 MMCF/hr**

11.4. Percent Sulfur of Primary Fuel: **NA** %

12. Secondary Fuel: ☐ Natural Gas ☐ Diesel ☐ Propane ☐ Biodiesel ☐ Other (specify): **NA**

General Information

12.1.	Maximum Annual Secondary Fuel Consumption: **MMCF**
12.2.	Heat Content of Secondary Fuel: **BTU/CF**
12.3.	Maximum Firing Rate: **MMCF/hr**
12.4.	Percent Sulfur of Secondary Fuel: %
13.	Is SCR/NSCR/SNCR/Ammonia Injection Used: ☐ YES ☒ NO

Stack Information

14. How Does the Process Equipment Vent:
(check all that apply)
☒ Directly to the Atmosphere
☐ Through a Control Device Covered by Forms AQM-4.1 through 4.12

If any of the process equipment vents directly to the atmosphere proceed to Question 15. If the process equipment vents through a control device, provide the stack parameters on the control device form and proceed to Question 16.

15. Emission Point Name: **EGen-4**

15.1. Stack Height Above Grade: **8.85 feet**

15.2. Stack Exit Diameter: **0.42 for each of 2 stacks feet**
(Provide Stack Dimensions If Rectangular Stack)

15.3. Is a Stack Cap Present? ☒ YES ☐ NO

15.4. Stack Configuration: ☒ Vertical ☐ Horizontal ☐ Downward-Venting
(check all that apply) ☐ Other (Specify):

15.5. Stack Exit Gas Temperature: **1,136 °F**

15.6. Stack Exit Gas Flow Rate: **2,529 ACFM**

15.7. Distance to Nearest Property Line: **53 ft**

15.8. Describe Nearest Obstruction: **Logistics Center building**

15.9. Height of Nearest Obstruction: **35 ft**

15.10. Distance to Nearest Obstruction: **23 ft**

15.11. Are Stack Sampling Ports Provided? ☐ YES ☒ NO

Monitoring Information

16. Will Emissions Data be Recorded by a Continuous Emission Monitoring System? ☐ YES ☒ NO

If Yes, Attach a Copy of the Continuous Emission Monitoring System Manufacturer's Specification Sheets

If YES, complete the rest of Question 16. If NO, proceed to Question 17.

16.1. Pollutants Monitored: ☐ VOCs ☐ HAPs ☐ PM ☐ PM_{10} ☐ $PM_{2.5}$ ☐ NO_X ☐ SO_X ☐ Metals
☐ Other (Specify):

16.2. Describe the Continuous Emission Monitoring System:

Monitoring Information

16.3. Manufacturer:

16.4. Model:

16.5. Serial Number:

16.6. Will Multiple Emission Units Be Monitored at the Same Point? ☐ YES ☐ NO

If YES, complete the rest of Question 16. If NO, proceed to Question 17.

16.7. Emission Units Monitored:

16.8. Will More Than One Emission Unit be Emitting From the Combined Point At Any Time? ☐ YES ☐ NO

If YES, complete the rest of Question 15. If NO, proceed to Question 17.

16.9. Emission Units Emitting Simultaneously:

Visible Emissions Monitoring Information

For Primary Fuel

17. Proposed Technique Used to Monitor Visible Emissions:
☐ Opacity Monitor (COM)
☐ Manual (Method 9)
☒ Manual (Method 22)
☐ Other (Describe):

If an Opacity Monitor (COM) is used, complete the rest of Question 17. If not, proceed to Question 18.

17.1. Describe the Continuous Opacity Monitoring System:

17.2. Manufacturer:

17.3. Model:

17.4. Serial Number:

18. Proposed Frequency of Opacity Monitoring: **Monthly**

For Secondary Fuel. If no Secondary Fuel is used, proceed to Question 20.

19. Proposed Technique Used to Monitor Visible Emissions:
☐ Opacity Monitor (COMs)
☐ Manual (Method 9)
☐ Manual (Method 22)
☐ Other (Describe):

If an Opacity Monitor (COMs) is used, complete the rest of Question 19. If not, proceed to Question 20.

19.1. Describe the Continuous Opacity Monitoring System:

19.2. Manufacturer:

19.3. Model:

19.4. Serial Number:

20. Proposed Frequency of Opacity Monitoring: **NA**

Voluntary Emission Limitation Request Information

21.	Are You Requesting Any Voluntary Emission Limitations to Avoid Major Source Status, Minor New Source Review, MACT, NSPS, etc.?	☐ YES ☒ NO
If YES, complete the rest of Question 21. If NO, proceed to Question 22.		
21.1.	Describe Any Proposed Emission Limitations:	

Voluntary Operating Limitation Request Information

22.	Are You Requesting Any Voluntary Operating Limitations to Avoid Major Source Status, Minor New Source Review, MACT, NSPS, etc.?	☐ YES ☒ NO
If YES, complete the rest of Question 22. If NO, proceed to Question 23.		
22.1.	Describe Any Proposed Operating Limitations:	

Additional Information

23.	Is There Any Additional Information Pertinent to this Application?	☒ YES ☐ NO
If YES, complete the rest of Question 23.		
22.1.	Describe: **Facility requests maximum 500 hours of operation per year on an as-needed basis.**	

Emissions Information Application

If you are using this form electronically, press F1 at any time for help

Process Information

1.	Number of Individual Pieces of Process Equipment in Process: **4**
2.	Number of Individual Control Devices in Process: **0**

Emissions Information for First Emission Point/Stack

3.	Emission Point Name: **EGen-1**
4.	Equipment ID Number for all Process Equipment and Control Devices Venting Through Emission Point/Stack: **EGen-1**
5.	Pollutant Emissions

If more than 15 pollutants are emitted at this Emission Point/Stack, attach additional copies of this page as needed.

	Pollutant Name (Specify VOCs and HAPs Individually in 5.10 through 5.18)	CAS Number (Not required for 5.1 through 5.10)	Maximum Uncontrolled Emission Rate at Design Capacity	Maximum Controlled Emission Rate at Design Capacity	Annual Potential to Emit (PTE)	Requested Permitted Annual Emissions
5.1.	Particulate Matter (PM)		**0.11 lbs/hour**	**0.11 lbs/hour**	**0.027** tons/year	**0.027** tons/year
5.2.	PM_{10}		**lbs/hour**	**lbs/hour**	tons/year	tons/year
5.3.	$PM_{2.5}$		**lbs/hour**	**lbs/hour**	tons/year	tons/year
5.4.	Sulfur Oxides (SO_X)		**0.003 lbs/hour**	**0.003 lbs/hour**	**0.0008** tons/year	**0.0008** tons/year
5.5.	Nitrogen Oxides (NO_X)		**0.08 lbs/hour**	**0.08 lbs/hour**	**0.02** tons/year	**0.02** tons/year
5.6.	Carbon Monoxide (CO)		**0.13 lbs/hour**	**0.13 lbs/hour**	**0.032** tons/year	**0.032** tons/year
5.7.	Total Volatile Organic Compounds (VOCs)		**0.01 lbs/hour**	**0.01 lbs/hour**	**0.002** tons/year	**0.002** tons/year
5.8.	Total Hazardous Air		**lbs/hour**	**lbs/hour**	tons/year	tons/year

Emissions Information for First Emission Point/Stack

	Pollutants (HAPs)					
5.9.	CO_2		**874 lbs/hour**	**874 lbs/hour**	**219** tons/year	**219** tons/year
5.10.	CO_{2e}		**lbs/hour**	**lbs/hour**	tons/year	tons/year
5.11.			**lbs/hour**	**lbs/hour**	tons/year	tons/year
5.12.			**lbs/hour**	**lbs/hour**	tons/year	tons/year
5.13.			**lbs/hour**	**lbs/hour**	tons/year	tons/year
5.14.			**lbs/hour**	**lbs/hour**	tons/year	tons/year
5.15.			**lbs/hour**	**lbs/hour**	tons/year	tons/year

6. Provide Any Additional Information Necessary to Understanding the Emission Rates Provided Above:

Attach the Basis of Determination or Calculations for each Emission Rate provided above.

Emissions Information for Second Emission Point/Stack

7. Emission Point Name: **EGen-2**

8. Equipment ID Number for all Process Equipment and Control Devices Venting Through Emission Point/Stack: **EGen-2**

9. Pollutant Emissions

If more than 15 pollutants are emitted at this Emission Point/Stack, attach additional copies of this page as needed.

	Pollutant Name (Specify VOCs and HAPs Individually in 9.10 through 9.18)	CAS Number (Not required for 9.1 through 9.10)	Maximum Uncontrolled Emission Rate at Design Capacity	Maximum Controlled Emission Rate at Design Capacity	Annual Potential to Emit (PTE)	Requested Permitted Annual Emissions
9.1.	Particulate Matter (PM)		**0.11 lbs/hour**	**0.11 lbs/hour**	**0.027** tons/year	**0.027** tons/year
9.2.	PM_{10}		**lbs/hour**	**lbs/hour**	tons/year	tons/year

Emissions Information for Second Emission Point/Stack

9.3.	$PM_{2.5}$		**lbs/hour**	**lbs/hour**	tons/year	tons/year
9.4.	Sulfur Oxides (SO_X)		**0.003 lbs/hour**	**0.003 lbs/hour**	**0.0008** tons/year	**0.0008** tons/year
9.5.	Nitrogen Oxides (NO_X)		**0.08 lbs/hour**	**0.08 lbs/hour**	**0.02** tons/year	**0.02** tons/year
9.6.	Carbon Monoxide (CO)		**0.13 lbs/hour**	**0.13 lbs/hour**	**0.032** tons/year	**0.032** tons/year
9.7.	Total Volatile Organic Compounds (VOCs)		**0.01 lbs/hour**	**0.01 lbs/hour**	**0.002** tons/year	**0.002** tons/year
9.8.	Total Hazardous Air Pollutants (HAPs)		**lbs/hour**	**lbs/hour**	tons/year	tons/year
9.9.	CO_2		**874 lbs/hour**	**874 lbs/hour**	**219** tons/year	**219** tons/year
9.10.	CO_{2e}		**lbs/hour**	**lbs/hour**	tons/year	tons/year
9.11.			**lbs/hour**	**lbs/hour**	tons/year	tons/year
9.12.			**lbs/hour**	**lbs/hour**	tons/year	tons/year
9.13.			**lbs/hour**	**lbs/hour**	tons/year	tons/year
9.14.			**lbs/hour**	**lbs/hour**	tons/year	tons/year
9.15.			**lbs/hour**	**lbs/hour**	tons/year	tons/year

10. Provide Any Additional Information Necessary to Understanding the Emission Rates Provided Above:

Attach the Basis of Determination or Calculations for each Emission Rate provided above.

Emissions Information for Third Emission Point/Stack

11. Emission Point Name: **EGen-3**

12. Equipment ID Number for all Process Equipment and Control Devices Venting Through Emission Point/Stack: **EGen-3**

Emissions Information for Third Emission Point/Stack

13. Pollutant Emissions

If more than 15 pollutants are emitted at this Emission Point/Stack, attach additional copies of this page as needed.

	Pollutant Name (Specify VOCs and HAPs Individually in 13.10 through 13.18)	CAS Number (Not required for 13.1 through 13.10)	Maximum Uncontrolled Emission Rate at Design Capacity	Maximum Controlled Emission Rate at Design Capacity	Annual Potential to Emit (PTE)	Requested Permitted Annual Emissions
13.1.	Particulate Matter (PM)		**0.11 lbs/hour**	**0.11 lbs/hour**	**0.027** tons/year	**0.027** tons/year
13.2.	PM_{10}		**lbs/hour**	**lbs/hour**	tons/year	tons/year
13.3.	$PM_{2.5}$		**lbs/hour**	**lbs/hour**	tons/year	tons/year
13.4.	Sulfur Oxides (SO_X)		**0.003 lbs/hour**	**0.003 lbs/hour**	**0.0008** tons/year	**0.0008** tons/year
13.5.	Nitrogen Oxides (NO_X)		**0.08 lbs/hour**	**0.08 lbs/hour**	**0.02** tons/year	**0.02** tons/year
13.6.	Carbon Monoxide (CO)		**0.13 lbs/hour**	**0.13 lbs/hour**	**0.032** tons/year	**0.032** tons/year
13.7.	Total Volatile Organic Compounds (VOCs)		**0.01 lbs/hour**	**0.01 lbs/hour**	**0.002** tons/year	**0.002** tons/year
13.8.	Total Hazardous Air Pollutants (HAPs)		**lbs/hour**	**lbs/hour**	tons/year	tons/year
13.9.	CO_2		**874 lbs/hour**	**874 lbs/hour**	**219** tons/year	**219** tons/year
13.10.	CO_{2e}		**lbs/hour**	**lbs/hour**	tons/year	tons/year
13.11.			**lbs/hour**	**lbs/hour**	tons/year	tons/year
13.12.			**lbs/hour**	**lbs/hour**	tons/year	tons/year
13.13.			**lbs/hour**	**lbs/hour**	tons/year	tons/year
13.14.			**lbs/hour**	**lbs/hour**	tons/year	tons/year
13.15.			**lbs/hour**	**lbs/hour**	tons/year	tons/year

Emissions Information for Third Emission Point/Stack

14. Provide Any Additional Information Necessary to Understanding the Emission Rates Provided Above:

Attach the Basis of Determination or Calculations for each Emission Rate provided above.

Emissions Information for Fourth Emission Point/Stack

15. Emission Point Name: **EGen-4**

16. Equipment ID Number for all Process Equipment and Control Devices Venting Through Emission Point/Stack: **EGen-4**

17. Pollutant Emissions

If more than 15 pollutants are emitted at this Emission Point/Stack, attach additional copies of this page as needed.

	Pollutant Name (Specify VOCs and HAPs Individually in 17.10 through 17.18)	CAS Number (Not required for 17.1 through 17.10)	Maximum Uncontrolled Emission Rate at Design Capacity	Maximum Controlled Emission Rate at Design Capacity	Annual Potential to Emit (PTE)	Requested Permitted Annual Emissions
17.1.	Particulate Matter (PM)		**0.11 lbs/hour**	**0.11 lbs/hour**	**0.027** tons/year	**0.027** tons/year
17.2.	PM_{10}		**lbs/hour**	**lbs/hour**	tons/year	tons/year
17.3.	$PM_{2.5}$		**lbs/hour**	**lbs/hour**	tons/year	tons/year
17.4.	Sulfur Oxides (SO_X)		**0.003 lbs/hour**	**0.003 lbs/hour**	**0.0008** tons/year	**0.0008** tons/year
17.5.	Nitrogen Oxides (NO_X)		**0.08 lbs/hour**	**0.08 lbs/hour**	**0.02** tons/year	**0.02** tons/year
17.6.	Carbon Monoxide (CO)		**0.13 lbs/hour**	**0.13 lbs/hour**	**0.032** tons/year	**0.032** tons/year
17.7.	Volatile Organic Compounds (VOCs)		**0.01 lbs/hour**	**0.01 lbs/hour**	**0.002** tons/year	**0.002** tons/year
17.8.	Total Hazardous Air Pollutants (HAPs)		**lbs/hour**	**lbs/hour**	tons/year	tons/year
17.9.	CO_2		**874 lbs/hour**	**874 lbs/hour**	**219** tons/year	**219** tons/year

Emissions Information for Fourth Emission Point/Stack

17.10. CO_{2e}		**lbs/hour**	**lbs/hour**	tons/year	tons/year
17.11.		**lbs/hour**	**lbs/hour**	tons/year	tons/year
17.12.		**lbs/hour**	**lbs/hour**	tons/year	tons/year
17.13.		**lbs/hour**	**lbs/hour**	tons/year	tons/year
17.14.		**lbs/hour**	**lbs/hour**	tons/year	tons/year
17.15.		**lbs/hour**	**lbs/hour**	tons/year	tons/year

18. Provide Any Additional Information Necessary to Understanding the Emission Rates Provided Above:

Attach the Basis of Determination or Calculations for each Emission Rate provided above.

If there are more than four Emission Points/Stacks, attach additional copies of this form as needed.

Overall Process Emissions

19. Pollutant Emissions

If more than 15 pollutants are emitted from this Process, attach additional copies of this page as needed.

Pollutant Name (Specify VOCs and HAPs Individually in 19.10 through 19.18)	CAS Number (Not required for 19.1 through 19.10)	Maximum Uncontrolled Emission Rate at Design Capacity	Maximum Controlled Emission Rate at Design Capacity	Annual Potential to Emit (PTE)	Requested Permitted Annual Emissions
19.1. Particulate Matter (PM)		**0.43 lbs/hour**	**0.43 lbs/hour**	**0.11** tons/year	**0.11** tons/year
19.2. PM_{10}		**lbs/hour**	**lbs/hour**	tons/year	tons/year
19.3. $PM_{2.5}$		**lbs/hour**	**lbs/hour**	tons/year	tons/year
19.4. Sulfur Oxides (SO_X)		**0.013 lbs/hour**	**0.013 lbs/hour**	**0.0033** tons/year	**0.0033** tons/year
19.5. Nitrogen Oxides (NO_X)		**0.32 lbs/hour**	**0.32 lbs/hour**	**0.08** tons/year	**0.08** tons/year

Overall Process Emissions

19.6.	Carbon Monoxide (CO)		**0.52 lbs/hour**	**0.52 lbs/hour**	**0.13** tons/year	**0.13** tons/year
19.7.	Total Volatile Organic Compounds (VOCs)		**0.04 lbs/hour**	**0.04 lbs/hour**	**0.01** tons/year	**0.01** tons/year
19.8.	Total Hazardous Air Pollutants (HAPs)		**lbs/hour**	**lbs/hour**	tons/year	tons/year
19.9.	CO_2		**3,497 lbs/hour**	**3,497 lbs/hour**	**874** tons/year	**874** tons/year
19.10.	CO_{2e}		**lbs/hour**	**lbs/hour**	tons/year	tons/year
19.12.			**lbs/hour**	**lbs/hour**	tons/year	tons/year
19.13.			**lbs/hour**	**lbs/hour**	tons/year	tons/year
19.14.			**lbs/hour**	**lbs/hour**	tons/year	tons/year
19.15.			**lbs/hour**	**lbs/hour**	tons/year	tons/year

20. Provide Any Additional Information Necessary to Understanding the Emission Rates Provided Above:

Attach the Basis of Determination or Calculations for each Emission Rate provided above.

Minor New Source Review Information

21. Does the Process Have the Potential to Emit More Than Five Tons Per Year of Any Pollutant? ☐ YES ☒ NO

22. Is the Source New or Existing? ☒ NEW ☐ EXISTING
See Question 11 of AQM-1

If the Process has the Potential to Emit more than five tons per year of any pollutant, and is a New Source, a Control Technology Analysis pursuant to Regulation No. 1125 Section 4 must be conducted and attached to this application.

Major New Source Review Information

23. Does the Process Have the Potential to Emit More Than the Significance Level for Any Pollutant? *(Check All That Apply)*

- ☐ Greater Than 25 Tons Per Year of Particulate Matter (PM)
- ☐ Greater Than 15 Tons Per Year of PM_{10}
- ☐ Greater Than 10 Tons Per Year of $PM_{2.5}$
- ☐ Greater Than 40 Tons Per Year of Sulfur Dioxide(SO_2)
- ☐ Greater Than 25 Tons Per Year of Nitrogen Oxides (NO_X) in New Castle and Kent County
- ☐ Greater Than 100 Tons Per Year of Nitrogen Oxides (NO_X) in Sussex County
- ☐ Greater Than 100 Tons Per Year of Carbon Monoxide (CO)
- ☐ Greater Than 25 Tons Per Year of Total Volatile Organic Compounds (VOCs) in New Castle and Kent County
- ☐ Greater Than 50 Tons Per Year of Total Volatile Organic Compounds (VOCs) in Sussex County
- ☐ Greater Than 75,000 Tons Per Year of Equivalent Carbon Dioxide (CO_{2e})

If the Process has the Potential to Emit greater than any of the amounts listed above 7 DE Admin. Code 1125 Sections 2 and/or 3 apply. Contact the Department at (302) 323-4542 or (302) 739-9402 for additional information

Additional Information

24. Is There Any Additional Information Pertinent to this Application? ☐ YES ☒ NO

If YES, complete the rest of Question 24.

24.1. Describe:

Emergency Generator

Kohler model 450REZXB

Power Rating	450	kW
Gas Consumption	5293	CF/hr
Gas Heat Content	1050	BTU/CF

Emission factors

NOx	0.08	g/kW-hr	Manufacturer
CO	0.13	g/kW-hr	Manufacturer
SOx	0.000588	lb/MMBTU	AP-42 Table 3.2-3
CO2	881.3	g/kW-hr	Manufacturer
PM	0.01941	lb/MMBTU	AP-42 Table 3.2-3
VOC	0.01	g/kW-hr	Manufacturer

Emissions per generator

			at 500 hours	
NOx	0.08	LB/HR	0.02	TON/YR
CO	0.13	LB/HR	0.032	TON/YR
SOx	0.003	LB/HR	0.0008	TON/YR
CO2	874	LB/HR	219	TON/YR
PM	0.11	LB/HR	0.027	TON/YR
VOC	0.01	LB/HR	0.002	TON/YR

Total emissions

			at 500 hours	
NOx	0.32	LB/HR	0.08	TON/YR
CO	0.52	LB/HR	0.13	TON/YR
SOx	0.013	LB/HR	0.0033	TON/YR
CO2	3,497	LB/HR	874	TON/YR
PM	0.43	LB/HR	0.11	TON/YR
VOC	0.04	LB/HR	0.01	TON/YR

3.2 Natural Gas-fired Reciprocating Engines

3.2.1 General[1-3]

Most natural gas-fired reciprocating engines are used in the natural gas industry at pipeline compressor and storage stations and at gas processing plants. These engines are used to provide mechanical shaft power for compressors and pumps. At pipeline compressor stations, engines are used to help move natural gas from station to station. At storage facilities, they are used to help inject the natural gas into high pressure natural gas storage fields. At processing plants, these engines are used to transmit fuel within a facility and for process compression needs (e.g., refrigeration cycles). The size of these engines ranges from 50 brake horsepower (bhp) to 11,000 bhp. In addition, some engines in service are 50 - 60 years old and consequently have significant differences in design compared to newer engines, resulting in differences in emissions and the ability to be retrofitted with new parts or controls.

At pipeline compressor stations, reciprocating engines are used to power reciprocating compressors that move compressed natural gas (500 - 2000 psig) in a pipeline. These stations are spaced approximately 50 to 100 miles apart along a pipeline that stretches from a gas supply area to the market area. The reciprocating compressors raise the discharge pressure of the gas in the pipeline to overcome the effect of frictional losses in the pipeline upstream of the station, in order to maintain the required suction pressure at the next station downstream or at various downstream delivery points. The volume of gas flowing and the amount of subsequent frictional losses in a pipeline are heavily dependent on the market conditions that vary with weather and industrial activity, causing wide pressure variations. The number of engines operating at a station, the speed of an individual engine, and the amount of individual engine horsepower (load) needed to compress the natural gas is dependent on the pressure of the compressed gas received by the station, the desired discharge pressure of the gas, and the amount of gas flowing in the pipeline. Reciprocating compressors have a wider operating bandwidth than centrifugal compressors, providing increased flexibility in varying flow conditions. Centrifugal compressors powered by natural gas turbines are also used in some stations and are discussed in another section of this document.

A compressor in storage service pumps gas from a low-pressure storage field (500 - 800 psig) to a higher pressure transmission pipeline (700 - 1000 psig) and/or pumps gas from a low-pressure transmission line (500 - 800 psig) to a higher pressure storage field (800 - 2000 psig).

Storage reciprocating compressors must be flexible enough to allow operation across a wide band of suction and discharge pressures and volume variations. The compressor must be able to compress at high compression ratios with low volumes and compress at low compression ratios with high volumes. These conditions require varying speeds and load (horsepower) conditions for the reciprocating engine powering the reciprocating compressor.

Reciprocating compressors are used at processing plants for process compression needs (e.g. refrigeration cycles). The volume of gas compressed varies, but the pressure needed for the process is more constant than the other two cases mentioned above.

3.2.2 Process Description[1-3]

Natural gas-fired reciprocating engines are separated into three design classes: 2-cycle (stroke) lean-burn, 4-stroke lean-burn, and 4-stroke rich-burn. Two-stroke engines complete the power cycle in a

single crankshaft revolution as compared to the two crankshaft revolutions required for 4-stroke engines. All engines in these categories are spark-ignited.

In a 2-stroke engine, the air-to-fuel charge is injected with the piston near the bottom of the power stroke. The intake ports are then covered or closed, and the piston moves to the top of the cylinder, compressing the charge. Following ignition and combustion, the power stroke starts with the downward movement of the piston. As the piston reaches the bottom of the power stroke, exhaust ports or valves are opened to exhaust, or scavenge, the combustion products, and a new air-to-fuel charge is injected. Two-stroke engines may be turbocharged using an exhaust-powered turbine to pressurize the charge for injection into the cylinder and to increase cylinder scavenging. Non-turbocharged engines may be either blower scavenged or piston scavenged to improve removal of combustion products. Historically, 2-stroke designs have been widely used in pipeline applications. However, current industry practices reflect a decline in the usage of new 2-stroke engines for stationary applications.

Four-stroke engines use a separate engine revolution for the intake/compression cycle and the power/exhaust cycle. These engines may be either naturally aspirated, using the suction from the piston to entrain the air charge, or turbocharged, using an exhaust-driven turbine to pressurize the charge. Turbocharged units produce a higher power output for a given engine displacement, whereas naturally aspirated units have lower initial costs and require less maintenance.

Rich-burn engines operate near the stoichiometric air-to-fuel ratio (16:1) with exhaust excess oxygen levels less than 4 percent (typically closer to 1 percent). Additionally, it is likely that the emissions profile will be considerably different for a rich-burn engine at 4 percent oxygen than when operated closer to stoichiometric conditions. Considerations such as these can impact the quantitative value of the emission factor presented. It is also important to note that while rich-burn engines may operate, by definition, with exhaust oxygen levels as high as 4 percent, in reality, most will operate within plus or minus 1 air-to-fuel ratio of stoichiometry. Even across this narrow range, emissions will vary considerably, sometimes by more than an order of magnitude. Air-to-fuel ratios were not provided in the gathered emissions data used to develop the presented factors.

Lean-burn engines may operate up to the lean flame extinction limit, with exhaust oxygen levels of 12 percent or greater. The air to fuel ratios of lean-burn engines range from 20:1 to 50:1 and are typically higher than 24:1. The exhaust excess oxygen levels of lean-burn engines are typically around 8 percent, ranging from 4 to 17 percent. Some lean-burn engines are characterized as clean-burn engines. The term "clean-burn" technology is a registered trademark of Cooper Energy Systems and refers to engines designed to reduce NO_x by operating at high air-to-fuel ratios. Engines operating at high air-to-fuel ratios (greater than 30:1) may require combustion modification to promote stable combustion with the high excess air. These modifications may include a turbo charger or a precombustion chamber (PCC). A turbo charger is used to force more air into the combustion chamber, and a PCC is used to ignite a fuel-rich mixture that propagates into the main cylinder and ignites the very lean combustion charge. Lean-burn engines typically have lower oxides of nitrogen (NO_x) emissions than rich-burn engines.

3.2.3 Emissions

The primary criteria pollutants from natural gas-fired reciprocating engines are oxides of nitrogen (NO_x), carbon monoxide (CO), and volatile organic compounds (VOC). The formation of nitrogen oxides is exponentially related to combustion temperature in the engine cylinder. The other pollutants, CO and VOC species, are primarily the result of incomplete combustion. Particulate matter (PM) emissions include trace amounts of metals, non-combustible inorganic material, and condensible,

semi-volatile organics which result from volatized lubricating oil, engine wear, or from products of incomplete combustion. Sulfur oxides are very low since sulfur compounds are removed from natural gas at processing plants. However, trace amounts of sulfur containing odorant are added to natural gas at city gates prior to distribution for the purpose of leak detection.

It should be emphasized that the actual emissions may vary considerably from the published emission factors due to variations in the engine operating conditions. This variation is due to engines operating at different conditions, including air-to-fuel ratio, ignition timing, torque, speed, ambient temperature, humidity, and other factors. It is not unusual to test emissions from two identical engines in the same plant, operated by the same personnel, using the same fuel, and have the test results show significantly different emissions. This variability in the test data is evidenced in the high relative standard deviation reported in the data set.

3.2.3.1 Nitrogen Oxides -

Nitrogen oxides are formed through three fundamentally different mechanisms. The principal mechanism of NO_x formation with gas-fired engines is thermal NO_x. The thermal NO_x mechanism occurs through the thermal dissociation and subsequent reaction of nitrogen (N_2) and oxygen (O_2) molecules in the combustion air. Most NO_x formed through the thermal NO_x mechanism occurs in high-temperature regions in the cylinder where combustion air has mixed sufficiently with the fuel to produce the peak temperature fuel/air interface. The second mechanism, called prompt NO_x, occurs through early reactions of nitrogen molecules in the combustion air and hydrocarbon radicals from the fuel. Prompt NO_x reactions occur within the flame and are usually negligible compared to the level of NO_x formed through the thermal NO_x mechanism. The third mechanism, fuel NO_x, stems from the evolution and reaction of fuel-bound nitrogen compounds with oxygen. Natural gas has negligible chemically bound fuel nitrogen (although some molecular nitrogen is present).

Essentially all NO_x formed in natural gas-fired reciprocating engines occurs through the thermal NO_x mechanism. The formation of NO_x through the prompt NO_x mechanism may be significant only under highly controlled situations in rich-burn engines when the thermal NO_x mechanism is suppressed. The rate of NO_x formation through the thermal NO_x mechanism is highly dependent upon the stoichiometric ratio, combustion temperature, and residence time at the combustion temperature. Maximum NO_x formation occurs through the thermal NO_x mechanism near the stoichiometric air-to-fuel mixture ratio since combustion temperatures are greatest at this air-to-fuel ratio.

3.2.3.2 Carbon Monoxide and Volatile Organic Compounds -

CO and VOC emissions are both products of incomplete combustion. CO results when there is insufficient residence time at high temperature to complete the final step in hydrocarbon oxidation. In reciprocating engines, CO emissions may indicate early quenching of combustion gases on cylinder walls or valve surfaces. The oxidation of CO to carbon dioxide (CO_2) is a slow reaction compared to most hydrocarbon oxidation reactions.

The pollutants commonly classified as VOC can encompass a wide spectrum of volatile organic compounds that are photoreactive in the atmosphere. VOC occur when some of the gas remains unburned or is only partially burned during the combustion process. With natural gas, some organics are carryover, unreacted, trace constituents of the gas, while others may be pyrolysis products of the heavier hydrocarbon constituents. Partially burned hydrocarbons result from poor air-to-fuel mixing prior to, or during, combustion, or incorrect air-to-fuel ratios in the cylinder during combustion due to maladjustment of the engine fuel system. Also, low cylinder temperature may yield partially burned hydrocarbons due to excessive cooling through the walls, or early cooling of the gases by expansion of the combustion volume caused by piston motion before combustion is completed.

3.2.3.3 Particulate Matter[4] -

PM emissions result from carryover of noncombustible trace constituents in the fuel and lubricating oil and from products of incomplete combustion. Emission of PM from natural gas-fired reciprocating engines are generally minimal and comprise fine filterable and condensible PM. Increased PM emissions may result from poor air-to-fuel mixing or maintenance problems.

3.2.3.4 Carbon Dioxide, Methane, and Nitrous Oxide[5] -

Carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) are referred to as greenhouse gases. Such gases are largely transparent to incoming solar radiation; however, they absorb infrared radiation re-emitted by the Earth. Where available, emission factors for these pollutants are presented in the emission factors tables of this section.

3.2.4 Control Technologies

Three generic control techniques have been developed for reciprocating engines: parametric controls (timing and operating at a leaner air-to-fuel ratio); combustion modifications such as advanced engine design for new sources or major modification to existing sources (clean-burn cylinder head designs and prestratified charge combustion for rich-burn engines); and postcombustion catalytic controls installed on the engine exhaust system. Post-combustion catalytic technologies include selective catalytic reduction (SCR) for lean-burn engines, nonselective catalytic reduction (NSCR) for rich-burn engines, and CO oxidation catalysts for lean-burn engines.

3.2.4.1 Control Techniques for 4-Cycle Rich-burn Engines[4,6] -

Nonselective Catalytic Reduction (NSCR) -

This technique uses the residual hydrocarbons and CO in the rich-burn engine exhaust as a reducing agent for NO_x. In an NSCR, hydrocarbons and CO are oxidized by O_2 and NO_x. The excess hydrocarbons, CO, and NO_x pass over a catalyst (usually a noble metal such as platinum, rhodium, or palladium) that oxidizes the excess hydrocarbons and CO to H_2O and CO_2, while reducing NO_x to N_2. NO_x reduction efficiencies are usually greater than 90 percent, while CO reduction efficiencies are approximately 90 percent.

The NSCR technique is effectively limited to engines with normal exhaust oxygen levels of 4 percent or less. This includes 4-stroke rich-burn naturally aspirated engines and some 4-stroke rich-burn turbocharged engines. Engines operating with NSCR require tight air-to-fuel control to maintain high reduction effectiveness without high hydrocarbon emissions. To achieve effective NO_x reduction performance, the engine may need to be run with a richer fuel adjustment than normal. This exhaust excess oxygen level would probably be closer to 1 percent. Lean-burn engines could not be retrofitted with NSCR control because of the reduced exhaust temperatures.

Prestratified Charge -

Prestratified charge combustion is a retrofit system that is limited to 4-stroke carbureted natural gas engines. In this system, controlled amounts of air are introduced into the intake manifold in a specified sequence and quantity to create a fuel-rich and fuel-lean zone. This stratification provides both a fuel-rich ignition zone and rapid flame cooling in the fuel-lean zone, resulting in reduced formation of NO_x. A prestratified charge kit generally contains new intake manifolds, air hoses, filters, control valves, and a control system.

3.2.4.2 Control Techniques for Lean-burn Reciprocating Engines[4,6] -

Selective Catalytic Reduction[4,6] -

Selective catalytic reduction is a postcombustion technology that has been shown to be effective in reducing NO_x in exhaust from lean-burn engines. An SCR system consists of an ammonia storage, feed, and injection system, and a catalyst and catalyst housing. Selective catalytic reduction systems selectively reduce NO_x emissions by injecting ammonia (either in the form of liquid anhydrous ammonia or aqueous ammonium hydroxide) into the exhaust gas stream upstream of the catalyst. Nitrogen oxides, NH_3, and O_2 react on the surface of the catalyst to form N_2 and H_2O. For the SCR system to operate properly, the exhaust gas must be within a particular temperature range (typically between 450 and 850°F). The temperature range is dictated by the catalyst (typically made from noble metals, base metal oxides such as vanadium and titanium, and zeolite-based material). Exhaust gas temperatures greater than the upper limit (850°F) will pass the NO_x and ammonia unreacted through the catalyst. Ammonia emissions, called NH_3 slip, are a key consideration when specifying a SCR system. SCR is most suitable for lean-burn engines operated at constant loads, and can achieve efficiencies as high as 90 percent. For engines which typically operate at variable loads, such as engines on gas transmission pipelines, an SCR system may not function effectively, causing either periods of ammonia slip or insufficient ammonia to gain the reductions needed.

Catalytic Oxidation -

Catalytic oxidation is a postcombustion technology that has been applied, in limited cases, to oxidize CO in engine exhaust, typically from lean-burn engines. As previously mentioned, lean-burn technologies may cause increased CO emissions. The application of catalytic oxidation has been shown to be effective in reducing CO emissions from lean-burn engines. In a catalytic oxidation system, CO passes over a catalyst, usually a noble metal, which oxidizes the CO to CO_2 at efficiencies of approximately 70 percent for 2SLB engines and 90 percent for 4SLB engines.

3.2.5 Updates Since the Fifth Edition

The Fifth Edition was released in January 1995. Revisions to this section since that date are summarized below. For further detail, consult the memoranda describing each supplement or the background report for this section. These and other documents can be found on the Clearinghouse for Inventories/Emission Factors (CHIEF) electronic bulletin board (919-541-5742), or on the new Emission Factor and Inventory Group (EFIG) home page (http://www.epa.gov/ttn/chief).

Supplement A, February 1996

- In the table for uncontrolled natural gas prime movers, the Source Classification Code (SCC) for 4-cycle lean-burn was changed from 2-01-002-53 to 2-02-002-54. The SCC for 4-cycle rich-burn was changed from 2-02-002-54 to 2-02-02-002-53.

- An SCC (2-02-002-53) was provided for 4-cycle rich-burn engines, and the "less than" symbol (<) was restored to the appropriate factors.

Supplement B, October 1996

- The introduction section was revised.

- Text was added concerning process description of turbines.

- Text concerning emissions and controls was revised.
- References in various tables were editorially corrected.
- The inconsistency between a CO_2 factor in the table and an equation in the footnote was corrected.

Supplement F, July 2000

- Turbines used for natural gas compression were removed from this section and combined with utility turbines in Section 3.1. Section 3.2 now only contains information on natural gas-fired reciprocating engines.
- All emission factors were updated based on emissions data points taken from 70 emission reports containing over 400 source tests. Many new emission factors have been incorporated in this section for speciated organic compounds, including hazardous air pollutants.

TABLE 3.2-1 UNCONTROLLED EMISSION FACTORS FOR 2-STROKE LEAN-BURN ENGINES[a]
(SCC 2-02-002-52)

Pollutant	Emission Factor (lb/MMBtu)[b] (fuel input)	Emission Factor Rating
Criteria Pollutants and Greenhouse Gases		
NO_x[c] 90 - 105% Load	3.17 E+00	A
NO_x[c] <90% Load	1.94 E+00	A
CO[c] 90 - 105% Load	3.86 E-01	A
CO[c] <90% Load	3.53 E-01	A
CO_2[d]	1.10 E+02	A
SO_2[e]	5.88 E-04	A
TOC[f]	1.64 E+00	A
Methane[g]	1.45 E+00	C
VOC[h]	1.20 E-01	C
PM10 (filterable)[i]	3.84 E-02	C
PM2.5 (filterable)[i]	3.84 E-02	C
PM Condensable[j]	9.91 E-03	E
Trace Organic Compounds		
1,1,2,2-Tetrachloroethane[k]	6.63 E-05	C
1,1,2-Trichloroethane[k]	5.27 E-05	C
1,1-Dichloroethane	3.91 E-05	C
1,2,3-Trimethylbenzene	3.54 E-05	D
1,2,4-Trimethylbenzene	1.11 E-04	C
1,2-Dichloroethane	4.22 E-05	D
1,2-Dichloropropane	4.46 E-05	C
1,3,5-Trimethylbenzene	1.80 E-05	D
1,3-Butadiene[k]	8.20 E-04	D
1,3-Dichloropropene[k]	4.38 E-05	C
2,2,4-Trimethylpentane[k]	8.46 E-04	B
2-Methylnaphthalene[k]	2.14 E-05	C
Acenaphthene[k]	1.33 E-06	C

Table 3.2-1. UNCONTROLLED EMISSION FACTORS FOR 2-STROKE LEAN-BURN ENGINES

(Continued)

Pollutant	Emission Factor (lb/MMBtu)[b] (fuel input)	Emission Factor Rating
Acenaphthylene[k]	3.17 E-06	C
Acetaldehyde[k,l]	7.76 E-03	A
Acrolein[k,l]	7.78 E-03	A
Anthracene[k]	7.18 E-07	C
Benz(a)anthracene[k]	3.36 E-07	C
Benzene[k]	1.94 E-03	A
Benzo(a)pyrene[k]	5.68 E-09	D
Benzo(b)fluoranthene[k]	8.51 E-09	D
Benzo(e)pyrene[k]	2.34 E-08	D
Benzo(g,h,i)perylene[k]	2.48 E-08	D
Benzo(k)fluoranthene[k]	4.26 E-09	D
Biphenyl[k]	3.95 E-06	C
Butane	4.75 E-03	C
Butyr/Isobutyraldehyde	4.37 E-04	C
Carbon Tetrachloride[k]	6.07 E-05	C
Chlorobenzene[k]	4.44 E-05	C
Chloroform[k]	4.71 E-05	C
Chrysene[k]	6.72 E-07	C
Cyclohexane	3.08 E-04	C
Cyclopentane	9.47 E-05	C
Ethane	7.09 E-02	A
Ethylbenzene[k]	1.08 E-04	B
Ethylene Dibromide[k]	7.34 E-05	C
Fluoranthene[k]	3.61 E-07	C
Fluorene[k]	1.69 E-06	C
Formaldehyde[k,l]	5.52 E-02	A

Table 3.2-1. UNCONTROLLED EMISSION FACTORS FOR 2-STROKE LEAN-BURN ENGINES (Concluded)

Pollutant	Emission Factor (lb/MMBtu)[b] (fuel input)	Emission Factor Rating
Indeno(1,2,3-c,d)pyrene[k]	9.93 E-09	D
Isobutane	3.75 E-03	C
Methanol[k]	2.48 E-03	A
Methylcyclohexane	3.38 E-04	C
Methylene Chloride[k]	1.47 E-04	C
n-Hexane[k]	4.45 E-04	C
n-Nonane	3.08 E-05	C
n-Octane	7.44 E-05	C
n-Pentane	1.53 E-03	C
Naphthalene[k]	9.63 E-05	C
PAH[k]	1.34 E-04	D
Perylene[k]	4.97 E-09	D
Phenanthrene[k]	3.53 E-06	C
Phenol[k]	4.21 E-05	C
Propane	2.87 E-02	C
Pyrene[k]	5.84 E-07	C
Styrene[k]	5.48 E-05	A
Toluene[k]	9.63 E-04	A
Vinyl Chloride[k]	2.47 E-05	C
Xylene[k]	2.68 E-04	A

[a] Reference 7. Factors represent uncontrolled levels. For NO_x, CO, and PM10, "uncontrolled" means no combustion or add-on controls; however, the factor may include turbocharged units. For all other pollutants, "uncontrolled" means no oxidation control; the data set may include units with control techniques used for NOx control, such as PCC and SCR for lean burn engines, and PSC for rich burn engines. Factors are based on large population of engines. Factors are for engines at all loads, except as indicated. SCC = Source Classification Code. TOC = Total Organic Compounds. PM10 = Particulate Matter ≤ 10 microns (μm) aerodynamic diameter. A "<" sign in front of a factor means that the corresponding emission factor is based on one-half of the method detection limit.

[b] Emission factors were calculated in units of (lb/MMBtu) based on procedures in EPA

Method 19. To convert from (lb/MMBtu) to (lb/10^6 scf), multiply by the heat content of the fuel. If the heat content is not available, use 1020 Btu/scf. To convert from (lb/MMBtu) to (lb/hp-hr) use the following equation:

$$\text{lb/hp-hr} = (\text{lb/MMBtu})\ (\text{heat input, MMBtu/hr})\ (1/\text{operating HP, 1/hp})$$

[c] Emission tests with unreported load conditions were not included in the data set.

[d] Based on 99.5% conversion of the fuel carbon to CO_2. CO_2 [lb/MMBtu] = (3.67)(%CON)(C)(D)(1/h), where %CON = percent conversion of fuel carbon to CO_2, C = carbon content of fuel by weight (0.75), D = density of fuel, 4.1 E+04 lb/10^6 scf, and h = heating value of natural gas (assume 1020 Btu/scf at 60°F).

[e] Based on 100% conversion of fuel sulfur to SO_2. Assumes sulfur content in natural gas of 2,000 gr/10^6 scf.

[f] Emission factor for TOC is based on measured emission levels of 43 tests.

[g] Emission factor for methane is determined by subtracting the VOC and ethane emission factors from the TOC emission factor. Measured emission factor for methane compares well with the calculated emission factor, 1.48 lb/MMBtu vs. 1.45 lb/MMBtu, respectively.

[h] VOC emission factor is based on the sum of the emission factors for all speciated organic compounds less ethane and methane.

[i] Considered $\leq 1\ \mu$m in aerodynamic diameter. Therefore, for filterable PM emissions, PM10(filterable) = PM2.5(filterable).

[j] No data were available for condensable PM emissions. The presented emission factor reflects emissions from 4SLB engines.

[k] Hazardous Air Pollutant as defined by Section 112(b) of the Clean Air Act.

[l] For lean burn engines, aldehyde emissions quantification using CARB 430 may reflect interference with the sampling compounds due to the nitrogen concentration in the stack. The presented emission factor is based on FTIR measurements. Emissions data based on CARB 430 are available in the background report.

Table 3.2-2. UNCONTROLLED EMISSION FACTORS FOR 4-STROKE LEAN-BURN ENGINES[a]
(SCC 2-02-002-54)

Pollutant	Emission Factor (lb/MMBtu)[b] (fuel input)	Emission Factor Rating
Criteria Pollutants and Greenhouse Gases		
NO_x[c] 90 - 105% Load	4.08 E+00	B
NO_x[c] <90% Load	8.47 E-01	B
CO[c] 90 - 105% Load	3.17 E-01	C
CO[c] <90% Load	5.57 E-01	B
CO_2[d]	1.10 E+02	A
SO_2[e]	5.88 E-04	A
TOC[f]	1.47 E+00	A
Methane[g]	1.25 E+00	C
VOC[h]	1.18 E-01	C
PM10 (filterable)[i]	7.71 E-05	D
PM2.5 (filterable)[i]	7.71 E-05	D
PM Condensable[j]	9.91 E-03	D
Trace Organic Compounds		
1,1,2,2-Tetrachloroethane[k]	<4.00 E-05	E
1,1,2-Trichloroethane[k]	<3.18 E-05	E
1,1-Dichloroethane	<2.36 E-05	E
1,2,3-Trimethylbenzene	2.30 E-05	D
1,2,4-Trimethylbenzene	1.43 E-05	C
1,2-Dichloroethane	<2.36 E-05	E
1,2-Dichloropropane	<2.69 E-05	E
1,3,5-Trimethylbenzene	3.38 E-05	D
1,3-Butadiene[k]	2.67E-04	D
1,3-Dichloropropene[k]	<2.64 E-05	E
2-Methylnaphthalene[k]	3.32 E-05	C
2,2,4-Trimethylpentane[k]	2.50 E-04	C
Acenaphthene[k]	1.25 E-06	C

Table 3.2-2. UNCONTROLLED EMISSION FACTORS FOR 4-STROKE LEAN-BURN ENGINES
(Continued)

Pollutant	Emission Factor (lb/MMBtu)[b] (fuel input)	Emission Factor Rating
Acenaphthylene[k]	5.53 E-06	C
Acetaldehyde[k,l]	8.36 E-03	A
Acrolein[k,l]	5.14 E-03	A
Benzene[k]	4.40 E-04	A
Benzo(b)fluoranthene[k]	1.66 E-07	D
Benzo(e)pyrene[k]	4.15 E-07	D
Benzo(g,h,i)perylene[k]	4.14 E-07	D
Biphenyl[k]	2.12 E-04	D
Butane	5.41 E-04	D
Butyr/Isobutyraldehyde	1.01 E-04	C
Carbon Tetrachloride[k]	<3.67 E-05	E
Chlorobenzene[k]	<3.04 E-05	E
Chloroethane	1.87 E-06	D
Chloroform[k]	<2.85 E-05	E
Chrysene[k]	6.93 E-07	C
Cyclopentane	2.27 E-04	C
Ethane	1.05 E-01	C
Ethylbenzene[k]	3.97 E-05	B
Ethylene Dibromide[k]	<4.43 E-05	E
Fluoranthene[k]	1.11 E-06	C
Fluorene[k]	5.67 E-06	C
Formaldehyde[k,l]	5.28 E-02	A
Methanol[k]	2.50 E-03	B
Methylcyclohexane	1.23 E-03	C
Methylene Chloride[k]	2.00 E-05	C
n-Hexane[k]	1.11 E-03	C
n-Nonane	1.10 E-04	C

Table 3.2-2. UNCONTROLLED EMISSION FACTORS FOR 4-STROKE LEAN-BURN ENGINES
(Continued)

Pollutant	Emission Factor (lb/MMBtu)[b] (fuel input)	Emission Factor Rating
n-Octane	3.51 E-04	C
n-Pentane	2.60 E-03	C
Naphthalene[k]	7.44 E-05	C
PAH[k]	2.69 E-05	D
Phenanthrene[k]	1.04 E-05	D
Phenol[k]	2.40 E-05	D
Propane	4.19 E-02	C
Pyrene[k]	1.36 E-06	C
Styrene[k]	<2.36 E-05	E
Tetrachloroethane[k]	2.48 E-06	D
Toluene[k]	4.08 E-04	B
Vinyl Chloride[k]	1.49 E-05	C
Xylene[k]	1.84 E-04	B

[a] Reference 7. Factors represent uncontrolled levels. For NO_x, CO, and PM10, "uncontrolled" means no combustion or add-on controls; however, the factor may include turbocharged units. For all other pollutants, "uncontrolled" means no oxidation control; the data set may include units with control techniques used for NOx control, such as PCC and SCR for lean burn engines, and PSC for rich burn engines. Factors are based on large population of engines. Factors are for engines at all loads, except as indicated. SCC = Source Classification Code. TOC = Total Organic Compounds. PM-10 = Particulate Matter ≤ 10 microns (μm) aerodynamic diameter. A "<" sign in front of a factor means that the corresponding emission factor is based on one-half of the method detection limit.

[b] Emission factors were calculated in units of (lb/MMBtu) based on procedures in EPA Method 19. To convert from (lb/MMBtu) to (lb/10^6 scf), multiply by the heat content of the fuel. If the heat content is not available, use 1020 Btu/scf. To convert from (lb/MMBtu) to (lb/hp-hr) use the following equation:

$$\text{lb/hp-hr} = (\text{lb/MMBtu})\ (\text{heat input, MMBtu/hr})\ (1/\text{operating HP, 1/hp})$$

[c] Emission tests with unreported load conditions were not included in the data set.

[d] Based on 99.5% conversion of the fuel carbon to CO_2. CO_2 [lb/MMBtu] = (3.67)(%CON)(C)(D)(1/h), where %CON = percent conversion of fuel carbon to CO_2, C = carbon content of fuel by weight (0.75), D = density of fuel, 4.1 E+04 lb/10^6 scf, and

h = heating value of natural gas (assume 1020 Btu/scf at 60 °F).

[e] Based on 100% conversion of fuel sulfur to SO_2. Assumes sulfur content in natural gas of 2,000 gr/10^6 scf.

[f] Emission factor for TOC is based on measured emission levels from 22 source tests.

[g] Emission factor for methane is determined by subtracting the VOC and ethane emission factors from the TOC emission factor. Measured emission factor for methane compares well with the calculated emission factor, 1.31 lb/MMBtu vs. 1.25 lb/MMBtu, respectively.

[h] VOC emission factor is based on the sum of the emission factors for all speciated organic compounds less ethane and methane.

[i] Considered ≤ 1 μm in aerodynamic diameter. Therefore, for filterable PM emissions, PM10(filterable) = PM2.5(filterable).

[j] PM Condensable = PM Condensable Inorganic + PM-Condensable Organic

[k] Hazardous Air Pollutant as defined by Section 112(b) of the Clean Air Act.

[l] For lean burn engines, aldehyde emissions quantification using CARB 430 may reflect interference with the sampling compounds due to the nitrogen concentration in the stack. The presented emission factor is based on FTIR measurements. Emissions data based on CARB 430 are available in the background report.

Table 3.2-3. UNCONTROLLED EMISSION FACTORS FOR 4-STROKE RICH-BURN ENGINES[a]
(SCC 2-02-002-53)

Pollutant	Emission Factor (lb/MMBtu)[b] (fuel input)	Emission Factor Rating
Criteria Pollutants and Greenhouse Gases		
NO_x[c] 90 - 105% Load	2.21 E+00	A
NO_x[c] <90% Load	2.27 E+00	C
CO[c] 90 - 105% Load	3.72 E+00	A
CO[c] <90% Load	3.51 E+00	C
CO_2[d]	1.10 E+02	A
SO_2[e]	5.88 E-04	A
TOC[f]	3.58 E-01	C
Methane[g]	2.30 E-01	C
VOC[h]	2.96 E-02	C
PM10 (filterable)[i,j]	9.50 E-03	E
PM2.5 (filterable)[j]	9.50 E-03	E
PM Condensable[k]	9.91 E-03	E
Trace Organic Compounds		
1,1,2,2-Tetrachloroethane[l]	2.53 E-05	C
1,1,2-Trichloroethane[l]	<1.53 E-05	E
1,1-Dichloroethane	<1.13 E-05	E
1,2-Dichloroethane	<1.13 E-05	E
1,2-Dichloropropane	<1.30 E-05	E
1,3-Butadiene[l]	6.63 E-04	D
1,3-Dichloropropene[l]	<1.27 E-05	E
Acetaldehyde[l,m]	2.79 E-03	C
Acrolein[l,m]	2.63 E-03	C
Benzene[l]	1.58 E-03	B
Butyr/isobutyraldehyde	4.86 E-05	D
Carbon Tetrachloride[l]	<1.77 E-05	E

Table 3.2-3. UNCONTROLLED EMISSION FACTORS FOR 4-STROKE RICH-BURN ENGINES (Concluded)

Pollutant	Emission Factor (lb/MMBtu)[b] (fuel input)	Emission Factor Rating
Chlorobenzene[l]	<1.29 E-05	E
Chloroform[l]	<1.37 E-05	E
Ethane[n]	7.04 E-02	C
Ethylbenzene[l]	<2.48 E-05	E
Ethylene Dibromide[l]	<2.13 E-05	E
Formaldehyde[l,m]	2.05 E-02	A
Methanol[l]	3.06 E-03	D
Methylene Chloride[l]	4.12 E-05	C
Naphthalene[l]	<9.71 E-05	E
PAH[l]	1.41 E-04	D
Styrene[l]	<1.19 E-05	E
Toluene[l]	5.58 E-04	A
Vinyl Chloride[l]	<7.18 E-06	E
Xylene[l]	1.95 E-04	A

[a] Reference 7. Factors represent uncontrolled levels. For NO_x, CO, and PM-10, "uncontrolled" means no combustion or add-on controls; however, the factor may include turbocharged units. For all other pollutants, "uncontrolled" means no oxidation control; the data set may include units with control techniques used for NOx control, such as PCC and SCR for lean burn engines, and PSC for rich burn engines. Factors are based on large population of engines. Factors are for engines at all loads, except as indicated. SCC = Source Classification Code. TOC = Total Organic Compounds. PM10 = Particulate Matter ≤ 10 microns (μm) aerodynamic diameter. A "<" sign in front of a factor means that the corresponding emission factor is based on one-half of the method detection limit.

[b] Emission factors were calculated in units of (lb/MMBtu) based on procedures in EPA Method 19. To convert from (lb/MMBtu) to (lb/10^6 scf), multiply by the heat content of the fuel. If the heat content is not available, use 1020 Btu/scf. To convert from (lb/MMBtu) to (lb/hp-hr) use the following equation:

$$\text{lb/hp-hr} = (\text{lb/MMBtu})(\text{heat input, MMBtu/hr})(1/\text{operating HP, 1/hp})$$

[c] Emission tests with unreported load conditions were not included in the data set.

[d] Based on 99.5% conversion of the fuel carbon to CO_2. CO_2 [lb/MMBtu] = (3.67)(%CON)(C)(D)(1/h), where %CON = percent conversion of fuel carbon to CO_2,

C = carbon content of fuel by weight (0.75), D = density of fuel, 4.1 E+04 lb/10^6 scf, and h = heating value of natural gas (assume 1020 Btu/scf at 60°F).

[e] Based on 100% conversion of fuel sulfur to SO_2. Assumes sulfur content in natural gas of 2,000 gr/10^6scf.

[f] Emission factor for TOC is based on measured emission levels from 6 source tests.

[g] Emission factor for methane is determined by subtracting the VOC and ethane emission factors from the TOC emission factor.

[h] VOC emission factor is based on the sum of the emission factors for all speciated organic compounds. Methane and ethane emissions were not measured for this engine category.

[i] No data were available for uncontrolled engines. PM10 emissions are for engines equipped with a PCC.

[j] Considered ≤ 1 μm in aerodynamic diameter. Therefore, for filterable PM emissions, PM10(filterable) = PM2.5(filterable).

[k] No data were available for condensable emissions. The presented emission factor reflects emissions from 4SLB engines.

[l] Hazardous Air Pollutant as defined by Section 112(b) of the Clean Air Act.

[m] For rich-burn engines, no interference is suspected in quantifying aldehyde emissions. The presented emission factors are based on FTIR and CARB 430 emissions data measurements.

[n] Ethane emission factor is determined by subtracting the VOC emission factor from the NMHC emission factor.

References For Section 3.2

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3. *Alternative Control Techniques Document - NO_x Emissions From Stationary Reciprocating Engines*, EPA-453/R-93-032, July 1993.

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5. *Limiting Net Greenhouse Gas Emissions In The United States, Volume II: Energy Responses,* Report for the Office of Environmental Analysis, Office of Policy, Planning and Analysis, Department of Energy (DOE), DOE/PE-0101 Volume II, September 1991.

6. C. Castaldini, *NO_x Reduction Technologies For Natural Gas Industry Prime Movers*, GRI-90/0215, Gas Research Institute, Chicago, IL, August 1990.

7. *Emission Factor Documentation for AP-42 Section 3.2, Natural Gas-Fired Reciprocating Engines*, EPA Contract No. 68-D2-0160, Alpha-Gamma Technologies, Inc., Raleigh, North Carolina, July 2000.

furlow associates
consulting engineers
650 naamans road • suite 211 • claymont, de 19703
302-798-3515 • 302-798-9799 fax

LETTER OF TRANSMITTAL

Date 6/15/2021	Job 20.019.002
Attn: Addie Spicer	
RE: ChristianaCare – Logistics Center	

TO: Tevebaugh Associates

X Shop Drawing Drawings Other: VIA: Email

COPIES	DESCRIPTION
1	Generator Submittal
	NO EXCEPTIONS NOTED

REMARKS:

Copy To:	
	SIGNED: Mark R. Minner

kee

furlow associates
consulting engineers
650 naamans road • suite 211 • claymont, de 19703
302-798-3515 • 302-798-9799 fax

LETTER OF TRANSMITTAL

Date 6/15/2021	Job 20.019.002
Attn: Addie Spicer	
RE: ChristianaCare – Logistics Center	

TO: Tevebaugh Associates

X Shop Drawing ☐ Drawings ☐ Other: VIA: Email

COPIES	DESCRIPTION
1	Generator Submittal
	NO EXCEPTIONS NOTED

REMARKS:

Copy To:	
	SIGNED: Mark R. Minner

kee

KOHLER®

IN POWER. SINCE 1920.

SUBMITTAL

FOR

(4) KOHLER MODEL 450REZXB GENERATORS

&

(1) MCP603 MASTER CONTROL PANEL

SHOP DRAWING REVIEW
FURLOW ASSOCIATES, INC.

X	First Submission	X	No Exceptions Noted
	Second Submission		Exceptions Noted (Do Not Resubmit)
	Third Submission		Revise & Resubmit (See Notes)
	Not Required		Rejected

Date Logged In 6/4/2021

Corrections or comments made on the shop drawings during this review do not relieve the contractor from compliance with requirements of the drawings and specifications. This check is only for review of general conformance with the design concept of the project and general compliance with the information given in the contract documents. The contractor is responsible for: confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating their work with that of all other trades; and performing their work in a safe and satisfactory manner.

Reviewed by MRM
Date: 6/14/2021

SUPPLIED BY

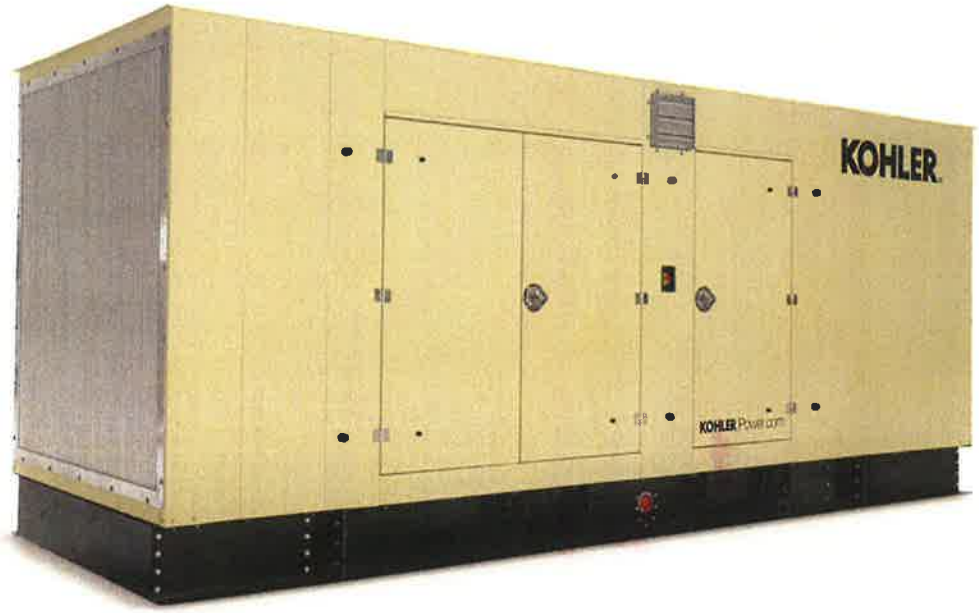
FIDELITY POWER SYSTEMS

TO

CHRISTIANA CARE

FOR

CHRISTIANA CARE LOGISTICS CENTER



FIDELITY

59-9219

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TABLE OF CONTENTS

SECTION A

FIDELITY
POWER SYSTEMS

FIDELITY
POWER SYSTEMS

Project: Christiana Care Logistics Center

KOHLER POWER SYSTEMS

Model: 450REZXD	**kW:** 450	**Voltage:** 277/480	**Phase:** 3	**Wire:** 4	**Hertz:** 60
Fuel: Natural Gas	**Cooling:** Radiator		**Configuration:** Outdoor		

Bill of Materials

Quantity (4) Digitally Paralleled Generators configured as follows:

Certifications:

- UL2200
- EPA Certified for Stationary, Emergency Application

Options Installed on Generators:

Controller:

- APM603 Full Color Touch Screen Controller with display of all electrical parameters, engine parameters and alarms. Equipped to provide on board paralleling including generator and load management. Utilizes Modbus, Ethernet or Bacnet communication protocols. Integral voltage regulation providing 0.25% voltage regulation
    - Controller options:
        - Dry Contacts I/O module
        - Run Relay
        - Manual Speed Adjust
        - Non-isolated port for Remote annunciator panel
        - Isolated port for Modbus devices
        - Isolated port for paralleling communications
        - (1) RJ45 port for Modbus TCP, SNMP, and BACnet

Enclosure:

- Kohler Factory Steel Sound Attenuated outdoor weather housing, with internally mounted critical silencer designed to reduce ambient noise level to approximately 72 dBA at 23 Feet.
    - Enclosure Options:
        - Includes electric package with AC/DC lights, GFCI outlets and switch.
        - Rodent guards/skid end caps
        - Stainless steel hinges and hardware

Engine Options:

- Electronic Governor
- Steel skid base with end caps and lube oil drain extension
- Initial fill of Lube Oil and Anti-Freeze
- (1) Maintenance Free Lead Acid Battery Set with Cables
- Kohler Battery Charger 10 Amp – factory prewired to load center
- Block Heater, 6000W, 208V, 1-phase - factory prewired to load center
- Alternator Strip Heater - factory prewired to load center

FIDELITY
POWER SYSTEMS

Circuit Breaker

- (1) Square D, 800 amp circuit breaker
  - Electronic LSI trip
  - 100% Rated
  - auxiliary contact
  - Alarm switch
  - **Equipped with electric motor operators for paralleling operation**

Ship Loose Items:

- (4) Remote Emergency Stops – 1 per unit
- (4) Remote Annunciators -1 per unit
- (3) Operations and Maintenance Manual (electronic and hard copies available)
- Miscellaneous:
  - Generator factory productions tests per specification on each unit

Testing and Warranty:

- Certified Factory Test Report
- Factory 0.8 Power Factor Test
- Job Site Delivery - Off loading by Others
  - Each generator to be delivered in 1 Piece
  - Unit overall Dimensions: 250.6"L X 88.7"W X 106.2"H
  - Overall weight: 16,420 lbs. – per unit
- Initial Startup on each unit
- Customer Demonstration and Training on-site – 8 hours included
- Jobsite 2-hour load test on each individual unit with portable resistive load bank – during normal business hours assuming reasonable access
- Jobsite overall digital paralleling system 2-hour load test – assuming reasonable access to switchboard GEDP
- Generator Warranty: 5-Year Basic begins on date of start-up

Automatic Transfer Switches:

- **None – ATS's are to be provided and priced by others**

Qty. (1) Master Control Panel (MCP603) – ships loose for install/wiring by others

- Wall mounted dimensions: 26.5"W x 66.5"H x 7.5"D
- NEMA 1 enclosure
- 12" color touchscreen
- Single line drawing of system provided on screen
- Metering of key generator data via Modbus RS-485
- ATS position/source availability via hardware connections
- Load management of up to 14 steps via hardwire connections

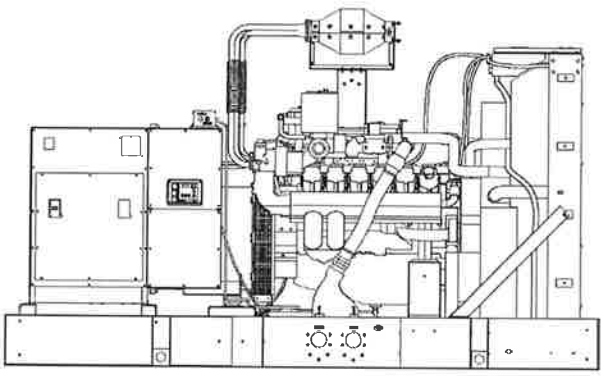
NOTE: PANEL 'GEDP' IS BEING PROVIDED BY OTHERS

PLEASE REFER TO THIS BILL OF MATERIALS FOR SPECIFIC RATINGS, VOLTAGE AND ACCESSORIES

Note: Fidelity Engineering reserves the right to re-submit on substitute accessory items of equal or greater quality than those submitted on in cases of extended delivery times.

KOHLER.

450REZXD
Natural Gas



Standard Features

- Kohler Co. provides one-source responsibility for the generating system and accessories.
- The generator set and its components are prototype-tested, factory-built, and production-tested.
- The 60 Hz generator set offers a UL 2200 listings.
- The generator set accepts rated load in one step.
- The 60 Hz emergency generator set meets NFPA 110, Level 1, when equipped with the necessary accessories and installed per NFPA standards.
- A one-year limited warranty covers all systems and components. Two-and five-year extended warranties are also available.
- Alternator Protection
- Battery Rack and Cables
- Closed Crankcase Ventilation (CCV) Filters
- Dual Fuel Reset Box (standard on dual fuel models)
- Integral Vibration Isolation
- Local Emergency Stop Switch

Alternator Features

- Low Coolant Level Shutdown
- Oil Drain Extension
- Secondary Gas Solenoid Value
- Three-Way Exhaust Catalyst
- The pilot-excited, permanent-magnet (PM) alternator provides superior short-circuit capability.

Other Features

- Natural gas is the primary fuel. Automatically transfers back to primary fuel when LP fuel becomes lwo or generator stops and restarts.
- The patented pending reset box on the generator provides the ability to manually transfer back to natural gas.
- The natural gas rating is available when running on natural gas.
- APM603 controller provides load shed for automatic derate to LP ratings to prevent an overload condition.

Generator Set Ratings

					Standby 130C Rise Ratings	
Alternator	Voltage	Ph	Hz	Peak kVA	kW/kVA	Amps
5M4028	277/480	3	60	2550	450 / 562	676

RATINGS: All three-phase units are rated at 0.8 power factor. All single-phase units are rated at 1.0 power factor.
Standby Ratings: The standby rating is applicable to varying loads for the duration of a power outage. There is no overload capability for this rating.

Model: 450REZXD, continued

Alternator Specifications

Specifications	Alternator
Alternator manufacturer	Kohler
Type	4-Pole, Rotating-Field
Exciter type	Brushless, Permanent-Magnet Pilot Exciter
Leads, quantity	10, Reconnectable
Voltage regulator	Solid State, Volts/Hz
Insulation	NEMA MG1
Insulation: Material	Class H, Synthetic, Nonhydroscopic
Insulation: Temperature Rise	130°C, 150°C Standby
Bearing: quantity, type	1, Sealed
Coupling	Flexible disc
Amortisseur windings	Full
Rotor balancing (60Hz)	125%
Voltage regulation, no-load to full-load RMS	Controller Dependent
One-Step Load Acceptance	100% of rating
Unbalanced load capability	100% of Rated Standby Current

- NEMA MG1, IEEE, and ANSI standards compliance for temperature rise and motor starting.
- Sustained short-circuit current of up to 300% of the rated current for up to 10 seconds.
- Sustained short-circuit current enabling down stream circuit breakers to trip without collapsing the alternator field.
- Self-ventilated and dripproof construction.
- Superior voltage waveform from a two-thirds pitch stator and skewed rotor.
- Brushless alternator with brushless pilot exciter for excellent load response.

Engine

Engine Specification

Engine Manufacturer	Doosan
Engine Model	D219L
Engine: type	21.9 L, 4-Cycle, Turbocharged, Charge Air-Cooled
Cylinder arrangement	V-12
Displacement, L (cu. in.)	21.9 (1336)
Bore and stroke, mm (in.)	128 x 142 (5.0 x 5.6)
Compression ratio	10.5:1
Piston speed, m/min. (ft./min.)	511 (1677)
Main bearings: quantity, type	14, Precision Half-Shell
Rated rpm	1800
Max. power at rated rpm, kWm (BHP)	510 (684)
Cylinder head material	Cast Iron
Crankshaft material	Forged Steel
Governor: type, make/model	Electronic
Frequency regulation, no-load to-full load	Isochronous
Frequency regulation, steady state	±0.5%
Frequency	Fixed
Air cleaner type, all models	Dry

Model: 450REZXD, continued

Exhaust

Exhaust System

Exhaust Manifold Type	Wet
Exhaust flow at rated kW, kg/hr. (cfm)	1932 (2529)
Maximum allowable back pressure after catalyst, kPa (in. Hg)	5.1 (1.5)
Exhaust temperature at rated kW, dry exhaust, °C (°F)	614 (1136)
Maximum allowable back pressure, kPa (in. Hg)	10.2 (3)
Exh. outlet size at eng. hookup, mm (in.)	See ADV Drawing

Engine Electrical

Engine Electrical System

Battery charging alternator: Ground (negative/positive)	Negative
Battery charging alternator: Volts (DC)	24
Battery charging alternator: Ampere rating	45
Starter motor rated voltage (DC)	24
Battery, recommended cold cranking amps (CCA): Qty., CCA rating each	Two, 925
Battery voltage (DC)	12

Fuel

Fuel System

Fuel type	Natural Gas
Fuel supply line inlet	3.0 NPTF
Natural gas/LPG fuel supply pressure, kPa (in. H20). Fuel supply pressure measured at the generator set fuel inlet downstream of any fuel system equipment accessories.	1.74-2.74 (7-11)

Fuel Composition

Fuel Composition

Natural Gas: Ethane, % by volume	4.0 max.
Natural Gas: Propane, % by volume	1.0 max.
Natural Gas: Propene, % by volume	0.1 max.
Natural Gas: C4 and higher, % by volume	0.3 max.
Natural Gas: Sulfur, ppm mass	25 max.
Natural Gas: Lower heating value, kJ/m3 (Btu/ft3), min.	33.2 (890)

* Fuels with other compositions may be acceptable. If your fuel is outside the listed specifications, contact your local distributor for further analysis and advice.

Lubrication

Lubrication System

Type	Full Pressure
Oil pan capacity, L (qt.)	40 (42.3)
Oil pan capacity with filter, L (qt.)	47.1 (49.7)
Oil filter: quantity, type	2, Cartridge
Oil cooler	Water-Cooled

Model: 450REZXD, continued

Cooling

Radiator System

Ambient temperature, °C (°F)	50 (122)
Engine jacket water capacity, L (gal.)	44 (12)
Radiator system capacity, including engine, L (gal.)	190 (51)
Engine jacket water flow, Lpm (gpm)	570 (151)
Heat rejected to cooling water at rated kW, dry exhaust, kW (Btu/min.)	516 (29345)
Heat rejected to air charge cooler at rated kW, dry exhaust, kW (Btu/min.)	65 (3686)
Water pump type	Centrifugal
Fan diameter, including blades, mm (in.)	1321 (52)
Fan, kWm (HP)	31 (42)
Max. restriction of cooling air, intake and discharge side of radiator, kPA (in. H20)	0.125 (0.5)

* Weather and sound enclosures with internal silencer reduce ambient temperature capability by 5°C (9°F).

Operation Requirements

Air Requirements

Radiator-cooled cooling air, m3/min. (scfm) *	870 (30700)
Combustion air, kg/hr. (cfm)	1821 (829)
Heat rejected to ambient air: Engine, kW (Btu/min.)	25 (1437)
Heat rejected to ambient air: Alternator, kW (Btu/min.)	23 (1580)

*Air density = 1.20 kg/m3 (0.075 lbm/ft3)

Fuel Consumption

450	Rating
Standby Fuel Consumption at 100% load	149.9 m3/hr. (5293 cfh)
Standby Fuel Consumption at 75% load	117.8 m3/hr. (4161 cfh)
Standby Fuel Consumption at 50% load	86.9 m3/hr. (3068 cfh)
Standby Fuel Consumption at 25% load	55.3 m3/hr. (2410 cfh)

KOHLER®

PSI 2020 Stationary & Mobile 60 Hz Certified Power Generation Rating Data															
Generator Model	Engine	Speed	Freq	Fuel	Duty Cycle	BHP	KWm	Flywheel power [2,3]		Engine Family	C02[6]	NOx[6]	CO[6]	VOC[5,7]	bsfc[5]	Catalyst
		RPM	Hz					HP	kW		(g/KW-hr)	(g/KW-hr)	(g/kW-hr)	(g/kW-hr)	(g/kW-hr)	
450REZXD	D219TIC, 21.9L	1800	60	NG	Emergency/Non-Emergency	684	510	650	484.7	LPSIB21.9NGP	881.3	0.08	0.13	0.01	0.22	Yes
	D219TIC, 21.9L	1800	60	LP	Emergency	684	510	472	352.0	LPSIB21.9NGP	590.7	0.03	0.34	0.05	0.27	Yes

[1] Standby and overload ratings based on ISO3046. Continuous ratings based on ISO 8528.

[2] All ratings are gross flywheel horsepower corrected to 77°F at an altitude of 328 feet with no cooling fan or alternator losses using heating value for NG of 1015 BTU/SCF.

[3] Production tolerances in engines and installed components can account for power variations of +/- 5%. Altitude, temperature and excessive exhaust and intake restrictions should be applied to power calculations.

[4] Electrical ratings are an estimated based on assumed fan and generator losses and may vary depending on actual equipment losses.

[5] Bsfc is based on 100% gross flywheel power rating and does not include fan or generator losses.

[6] Emissions shown are certified third-party Zero-hour data points suitable for site permitting calculations

[7] For NG, NMHC is reported in place of VOC for this report

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
2021 MODEL YEAR
CERTIFICATE OF CONFORMITY
WITH THE CLEAN AIR ACT

OFFICE OF TRANSPORTATION AND AIR QUALITY
ANN ARBOR, MICHIGAN 48105

Certificate Issued To: **Power Solutions International, Inc.**
(U.S. Manufacturer or Importer)

Certificate Number: **MPSIB21.9NGP-020**

Effective Date: 07/15/2020

Expiration Date: 12/31/2021

Byron J. Bunker, Division Director
Compliance Division

Issue Date: 07/15/2020

Revision Date: N/A

Manufacturer: Power Solutions International, Inc.
Engine Family: MPSIB21.9NGP
Mobile/Stationary Certification Type: Mobile and Stationary
Fuel : LPG/Propane
Natural Gas (CNG/LNG)
Emission Standards :
Part 60 Subpart JJJJ Table 1
NOx (g/Hp-hr) : 1.0
CO (g/Hp-hr) : 2.0
VOC (g/Hp-hr) : 0.7
Mobile Part 1048
HC + NOx (g/kW-hr) : 2.7
NMHC + NOx (g/kW-hr) : 2.7
CO (g/kW-hr) : 4.4
Stationary Part 1048
NMHC + NOx (g/kW-hr) : 2.7
HC + NOx (g/kW-hr) : 2.7
CO (g/kW-hr) : 4.4
Emergency Use Only : N

Pursuant to Section 213 of the Clean Air Act (42 U.S.C. section 7547) and 40 CFR Part 60, 40 CFR Part 1048, 1065, 1068, and 60 (stationary only and combined stationary and mobile) and subject to the terms and conditions prescribed in those provisions, this certificate of conformity is hereby issued with respect to the test engines which have been found to conform to applicable requirements and which represent the following nonroad engines, by engine family, more fully described in the documentation required by 40 CFR Part 60, 40 CFR Part 1048 and produced in the stated model year.

This certificate of conformity covers only those new nonroad spark-ignition engines which conform in all material respects to the design specifications that applied to those engines described in the documentation required by 40 CFR Part 60, 40 CFR Part 1048 and which are produced during the model year stated on this certificate of the said manufacturer, as defined in 40 CFR Part 60, 40 CFR Part 1048. This certificate of conformity does not cover nonroad engines imported prior to the effective date of the certificate.

It is a term of this certificate that the manufacturer shall consent to all inspections described in 40 CFR 1068.20 and authorized in a warrant or court order. Failure to comply with the requirements of such a warrant or court order may lead to revocation or suspension of this certificate for reasons specified in 40 CFR Part 60, 40 CFR Part 1048. It is also a term of this certificate that this certificate may be revoked or suspended or rendered void *ab initio* for other reasons specified in 40 CFR Part 60, 40 CFR Part 1048.

This certificate does not cover large nonroad engines sold, offered for sale, or introduced, or delivered for introduction, into commerce in the U.S. prior to the effective date of the certificate.